Project no. 231807

EPIWORK

Developing the Framework for an Epidemic Forecast Infrastructure

First period activity report

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PROJECT PERIODIC REPORT

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[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Declaration by the scientific representative of the project coordinator[1]

I, as scientific representative of the coordinator[1] of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate):

  ☐ has fully achieved its objectives and technical goals for the period;

  ☐ has achieved most of its objectives and technical goals for the period with relatively minor deviations[3];

  ☐ has failed to achieve critical objectives and/or is not at all on schedule[4].

- The public website is up to date, if applicable.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator[1]: ....

Date: ..../ ..../ ....

Signature of scientific representative of the Coordinator[1]: ....

[3] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.
[4] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

1. Publishable summary

EPIWORK is a project sponsored by the Future and Emerging Technologies program of the European Community proposing a multidisciplinary research effort aimed at developing the appropriate framework of tools and knowledge needed for the design of epidemic forecast infrastructures.

The huge flow of quantitative social, demographic and behavioural data becoming available nowadays motivates the development of innovative technologies that can improve the traditional disease-surveillance systems, providing faster and better-localized detection capabilities. Improved ICT techniques and methodologies, supporting inter-linkage and integration of datasets, can change the way epidemic processes are modelled. For the first time, ICT and computation enable the study of epidemic in a comprehensive fashion addressing the complexity inherent to the biological, social and behavioural aspects of health related problems. In this context, the EPIWORK project proposes a visionary research aimed at giving scientific foundations to the development of the needed modelling, computational and ICT tools such as mathematical and computational methods to predict the disease spreading in complex social systems, the development of large scale, data-driven computational models with a high level of realism, the design and implementation of original data-collection schemes through innovative Web and ICT applications, the setting up of a computational platform for epidemic research and data sharing to generate fruitful synergies between research communities and countries.

- ***Objectives***

A fully operational, accurate and reliable epidemic forecast infrastructure nowadays faces problems related to the lack of appropriate models to understand how an infectious disease spreads in the real world, lack of extensive and accurate epidemiologically relevant data (from societal data to epidemic surveillance data), lack of understanding of the interplay among the various scales of the problem (from the host-pathogen interaction, to human-to-human transmission, to the interaction with the environment) and most importantly lack of communication among the different areas of research which proceed almost independently, crucially hampering a significant progress in a highly interdisciplinary field of research. The present project intends to fill this gap. *Through computational thinking, complex systems concepts and data integration tools relevant for epidemiological understanding at all levels, it will provide a set of radical, paradigm-changing results enabling a novel approach to the modelling, forecast and policy making approach to infectious diseases.* The projects overarching goals are:

- The identification of general principles and laws that characterize complexity and capture the essence of *complex epidemiological systems*.
- The development of a *collaborative information platform* enabling the production of knowledge, understanding and models from the novel *abundance of digital data in epidemic research*.
- The development of an *open, data driven, computational modelling platform* to be used in epidemic research as well as in policy making for the analysis of global epidemics, integrating and leveraging on transnational data.
- The development, deployment and validation of an *Internet-based Monitoring System (IMS) producing real time data on disease incidence and epidemic spreading*.

- ***Overall strategy and general description***

The project aims at exploring the following *work areas* as the major research themes directly matching the objectives of this proposal: i) ***Modelling and theoretical foundations; ii) Data-driven***

computational platform*; *iii) ICT monitoring and reporting system. The work plan is organized around six distinct scientific work packages (WP1-WP6) aimed at providing a virtuous feedback cycle between tool development, data collection, analysis and modelling. Parallel scheduling of the work packages is necessary to jump-start the cycle and the Inter-WP validation. The research plan is structured so as to foster a fruitful interplay between the various components of the project. WP1 and WP2 are aimed at exploring theoretical issues in the area of epidemic modelling in complex, multi-scale systems, structured populations and in the presence of the dynamical interplay between social and technological factors, seasonality and climate, health policies implementations, WP3 and WP4 are devoted to the collection and sharing of data on a computational platform and have a two way continuous exchange with WP1 and WP2 of data and algorithms. WP5 and WP6 is aimed at developing, set-up and deployment of innovative web monitoring and data gathering tools that provide a continuous stream of data to WP3-WP4 and is informed by constant feedback on the modeling needs in terms of data gathering by WP1 and WP2. The common research agenda of the consortium teams, which work in a coordinated way on the various tasks, favors a closer interchange of ideas and knowledge among the groups and the various components of the project in a truly interdisciplinary collective effort.

Each WP includes several core disciplines expertise and it is anchored to the epidemiology area by the presence of mathematical biologists, epidemiologists and public health experts. These groups will provide the main research questions, the basic disease parameters choices and the relevant complex features of epidemiological systems as well as their contribution in the development of cross-fertilized and novel approaches targeted in the WPs. WP7 is management. This project is initiated by a group of senior scientists, working at the best research institutions in Europe. The Institute of Scientific Interchange (ISI), Turin, provides the management of the project and the coordination of the consortium. Finally, WP8 is devoted to outreach and dissemination activities.

The project description readily conveys the need for a wide variety of skills competencies, ranging from complex systems theory and computational modeling to computer science, statistical physics and epidemiology. The consortium consists of **12 teams in 8 different countries** that provide these competencies and that have skills and expertise that are documented by numerous publications and participation and leadership roles in previous European network projects:

1. **ISI – Institute for Scientific Interchange Foundation (Italy)**
2. **FGC-IGC – Fundaçao Calouste Gulbenkian - Instituto Gulbenkian de Ciência, (Portugal)**
3. **TAU – Tel Aviv University (Israel)**
4. **MPG – Max Planck Institute for Dynamics and Self-Organization (Germany)**
5. **AIBV – Acquisto Inter BV (The Netherlands)**
6. **London School of Hygiene and Tropical Medicine (UK)**
7. **SMI – The Swedish Institute for Infectious Disease Control (Sweden)**
8. **KULeuven – Katholieke Universiteit Leuven (Belgium)**
9. **BIU – Bar Llan University (Israle)**
10. **FBK – Fondazione Bruno Kessler (Italy)**
11. **CREATE-NET – Center for Research and Telecommunication Experimentation for NETworked communities**
12. **FFCUL – Faculty of Sciences University of Lisbon**

- ***Work performed and main results achieved since the beginning of the project***

In its first year of life the project has progressed according to the planned timeline and in many cases ahead of schedule. A framework for the communication within the consortium participants as well as the associated partners has been set up from the very beginning. The project website has been timely setup providing an overview about the project and give full access to press material and publications. The website is located at http://www.epiwork.eu An internal area of the project website is being used for the exchange of information between the partners keeping them updated

about the work in progress and providing assistance on development of special working groups. The full consortium has met twice in Turin for the kick-off meeting and the first annual meeting. Work packages had parallel meeting organized during the main annual meeting and at independent dates and venues when needed (a complete list of meetings and events is reported in the yearly management report). The project has completed successfully all the deliverables. Here we provide a list of the main achievements in the three main work areas of the project.

Modelling and theoretical foundations. Both WP1 and WP2 and have produced a number of results linking network structure, population behavior and epidemics. The London School of Tropical Health team has studied extensively the impact of clustered contact networks on sexually transmitted diseases, taking HIV as a case study. Using theoretical models, the University of Lisbon Portugal group, has examined how spatially restricted contact networks, namely those with power law distributed connectivity, yield super-diffusive spreading, and thus influence epidemic threshold behavior, especially for models with re-infection The Bar Ilan University group provide a unique mathematical analysis of how vaccination strategies need to be modified when contact networks are clustered, if they are to be effective. The Tel Aviv group has carried out a theoretical analysis of clustered contact networks that gives clear predictions of how clustering (as measured by the relative number of triangles in a network) controls the epidemic size and the epidemic threshold. In WP2 the MPG team has made considerable progress was made concerning the computation of multi-scale community structure and effective geographic borders. In addition to existing methods for community detection in complex networks based on network modularity maximization, they developed a new efficient technique based on the analysis of sets of shortest path trees in the network. The approach not only permits the geographic identification of locations of effective borders but also provides a means to quantify their significance and strength. The ISI group has tackled some general theoretical questions that concerns the basic understanding of the impact of mobility multi-scale networks and their spatial embedding on the spatial spread of infectious diseases on the large scale: i) Is there a most relevant mobility scale in the definition of the global epidemic pattern? ii) At which level of resolution of the epidemic behavior a given mobility scale starts to be relevant and to which extent? The techniques developed in this work allow for an understanding of the level of data integration required to obtain reliable results in large scale modeling of infectious diseases and have already have contributed to the improvement of the computational model we use to provide estimates and projections of the H1N1 pandemic.

Data-driven computational platform progress. In the context of the WP3 and WP4 the project has obtained major progress by the delivery of the first operational prototype of the Epidemic Marketplace in the November 2009 meeting in Torino, and made available to Consortium members since then from http://epiwork.di.fc.ul.pt. In January 2010, we initiated the deployment of a new version of the EM base software. The data collection activities have been started and have found synergies with the WP2 where a dedicated high performance mysql database server was instantiated. This server manages and maintains large-scale databases of records of mobility related data. On the computational tool side the activity the *Epidemic Modelling Platform* has progressed with the design of a client-server architecture tailored for the implementation and control through an appropriate GUI of the epidemic simulation software. At the moment the implementation is wrapped around the Global Epidemic and Mobility software that will be the first simulation tool to be incorporated in the platform. The project has progressed much ahead of schedule in the development and analysis of data-driven simulations for case studies analysis and epidemic forecasts in view of the H1N1pdm unfolding. The FBK, ISI and MPG teams have been used different simulation and computational approaches to provide real time, quantitative analysis of the spatial spreading of the H1N1 pandemic. Most of this work has been performed in close contact with national and international agencies, taking active part to the international effort aimed at minimizing the impact of the pandemic in the world. The project has also produced considerable advances in the study of techniques to integrate different simulation approaches at once. This has

led to the development of techniques to align parameters and initial condition in different modeling approaches. This joint work between the ISI and FBK teams is the first side-by-side comparison of large scale structured metapopulation and agent based modeling approaches.

ICT monitoring and reporting system. The work in this area has produced major advances in coordinating the IMS systems. The database contents of the already existing local IMS platform have been collected in a centralized repository that provided an extensive source of epidemiological data. During the first WP5 meeting (25-26 May 2009) in Amsterdam and Epiwork project meeting (15-18 November 2009) the discussion among the partners has led to the preparation in December 2009 of a draft for the design of the European centralized database, again brought forward by the occurrence of the H1N1 pandemic. In parallel the content update of the IMS platforms and a new website design process for the first Influenzanet website has been started. This new web infrastructure has been designed to deploy the local IMS in the several countries participating to the project, both new and existing. At the same time a fully functioning technical infrastructure for the population based approach (PBA) surveillance was up and running in early September 2009, well ahead of schedule. A representative reporting cohort has been established through random sampling of approximately 5,000 individuals (all ages) selected from the complete and continuously updated population register. The PBA results in regard to influenza-like illness (ILI) are displayed on the website of SMI and a comparison with traditional surveillance data has been made. The IMS was deployed in UK in the early summer of 2009, thanks in particular to the joint effort of the UK, Portuguese and Italian teams. The implementation of this was brought forward due to the H1N1 pandemic. Information is currently being collected from over 5500 participants across the UK (making the UK survey the third largest survey within the network).

The H1N1 pandemic challenge. After a few months in the life of the project the consortium has been involved in the effort of the international scientific community to fight the 2009 H1N1 pandemic. All teams of the consortium have been actively involved in the data gathering, computational analysis and monitoring in close contact with national and International agencies, including the JRC crisis unit, the ECDC and Institute or Ministry of Health of most of the countries represented in the project. On a side the H1N1 pandemic has represented and exceptional strain and workload for the teams on the other side it has forced the implementation and test of theoretical models, computational tools and the IMS infrastructure ahead of time, thus inducing great momentum to the entire project. The project achieved several major achievements related to the H1N1 pandemic. The Tel Aviv University group has obtained relevant results concerning the contact network structure of the Israeli population and the manner it affected the spread of the swine flu pandemic in 2009. Three teams of the consortium have been using computational models to produce projections of the spread of the ongoing H1N1 Flu epidemic. The work done for the realistic modelling of the H1N1 pandemic has to be considered as a major breakthrough that has shown for the first time, in a real world situation, the potential of computational methods in providing anticipations and forecasts that can be used in the support of the policy making and public health decision-making processes. The results obtained a very good agreement between predictions and real data, providing a strong and remarkable test of the quantitative level of the prediction offered by computational methods. All Epiwork teams involved in the Epiwork Internet-based Monitoring Systems for Influenza surveillance have carried on an enhanced surveillance during the whole pandemic. The IMS has been readily implemented in UK in July to cope with the emergency of the rising number of H1N1 cases. The results of the IMS activity in the different countries are collected on the Influenzanet page and being analyzed. The comparison of the data from the IMS with the traditional surveillance is very encouraging and a full retrospective data analysis will result to be extremely valuable to improve the IMS and as a test of its reliability. *It is work remarking that all the activities concerning H1N1 carried out in the consortium do not represent a deviation from the planned work. All Activities have contributed to specific tasks of the project and produced advances (in most cases ahead of schedule) of the planned work.*

2. Project objectives for the period

During the reporting period, each WP had very specific objectives along with a general progress in several defined tasks. Here we list the project objectives by work areas and identifying the responsible WP.

Modelling and theoretical foundations.

In this area the project objectives were concerning the modelling of population contact networks and the structure of interacting populations. In particular, WP1 was expected to tackle problems concerning population contact networks which characterize the non-random and often clustered manner in which individuals in a large population come into contact, and represented usually in the form of a connectivity matrix of graph. The work carried in this first period had the goal to explore how heterogeneities due to population aggregations and spatial structuring control epidemic size and extinction threshold. Classical theory has largely been concerned with random contact networks structure, while this first theme in the Epiwork project's research aims to push this to more realistic scenarios (WP1, D1.1). At the same time, WP2 objective for the first reporting period concerns is the development of systematic approaches that can identify and quantify modularity in spatially structured and heterogeneous meta-populations and contact networks and to employ community structure identification algorithms to identify the effective community structure in multi-scale mobility networks. A concrete step in this direction was also the development of a database server to maintain manages and maintains large-scale databases of records of mobility related data employed in this project (WP2, D2.1).

Data-driven computational platform progress. One of the main objectives of the project is the development of this information platform to mediate access to distributed collections of data gathered from multiple and heterogeneous sources. During the first reporting period the WP3 goals are the specification of the platform requirements, to catalogue relevant data (WP3: D3.1) and finally deploy a prototype of the so called Epidemic Marketplace with an initial set of epidemiological databases integrated available to project participants (WP3:D3.2). The development of a computational platform that can provide the access to the state-of-the art modelling approaches to perform data-driven simulations of epidemic outbreaks is the main research objective of Work Package 4. During this first project period, the work is focused on the integration of data into modelling algorithms and developing data and simulation results visualizations. Map layers can be vertically overlayed and integrated to provide, for example, insight into the correlations of the observed patterns with infrastructures. Map distortions can provide an additional perspective on the patterns linking health data with environmental and socio-economic data. The final overall goal of the first period is to develop innovative visualization techniques that would cope with the multiple levels of representation considered in the models (WP4: D4.1).

ICT monitoring and reporting system.

The project intends to overcome the limitation of the state of the art surveillance systems by proposing an innovative ICT approach based on Web2.0 tools. Starting from the successful experiences of internet-based monitoring system in the Netherland and in Portugal, the project plans to deploy an innovative real-time surveillance system across European countries. The first year of the project has the objective of enhancing the portability of this interactive and efficient system and extending its implementation into two new countries: Sweden, UK. At the end of the project the system will be extended to five new countries in total, adding France, Spain and Germany to the former two. In particular, the main objectives of the first project's year were the design of a "Gold Standard" set of ILI symptoms, the database infrastructure preparation, internet database design, translation of educational and informative contents and testing (WP5: D5.1, D5.2). Finally, to overcome possible biases linked to the self-selection into IMS, the Work Package 6 is devoted to provide a comparative analysis of three different surveillance systems in Sweden: the traditional GP system, a IMS system deployed in Sweden, a population-based approach (PBA) based on

experiences from large-scale pilot studies involving approximately 3,500 randomly selected individuals in Stockholm. This will add to the validation of the IMS and may permit future calibration of the IMS data. The first project period would be devoted to obtain ethical approval for the IMS and the PBA surveillance and to set up a fully functional technical infrastructure for the PBA surveillance (WP6; D6.1).

Along with the research and development work, the project activities include the ***Management*** and the ***Dissemination, collaboration and exploitation*** efforts. In both areas the project has defined for the first year a defined number of activities and objectives such as the consortium meetings, the formation of an advisory board, the preparation of the management and scientific reports (WP7: D7.1; D7.5), the project presentation (WP8: D8.1), the project webpage (WP8: D8.2) and the dissemination report (WP8:D8.6).

3. Work progress and achievements during the period

WP1
Population models and contact networks
Lead contractor: Tel Aviv University

Objectives WP1. As there is a large gap between the classical epidemiological theory with its stylized models, and complex real world disease dynamics, work package WP1 intends to create new Theoretical Foundations that are intended to help significantly fill the gap. The central themes addressed in WP1 are: Contact networks, epidemic seasonal drivers, intervention strategies and reinfection models, and parameter estimation techniques. The goal is to bring together advances from network theory, nonlinear dynamics and modern statistics, and develop new cutting-edge modeling tools that have relevance and will make a difference in real world epidemic modeling.

Progress towards objectives. As in other work packages, all groups have progressed at a rapid rate spurred on by the 2009 pandemic. Details of the progress for each of the individual WP1 themes are given below:

Theme 1: Contact Networks

Task 1. Heterogeneous individuals and interactions: one of the first issue that arises when trying to model human behavior concerns the many different types of interactions and the marked heterogeneities in the number of contacts that characterize human behavior. It is therefore imperative that this variation within the population is included in the models and method developed to identify high-risk individuals and potential superspreaders.

Task 2. Contact tracing: a powerful intervention strategy is to trace back contacts of infected people, either for treatment or isolation, allowing efforts to be focused towards those areas of a contact network that are known to be at risk. When limited resources are available, the implementation of contact tracing makes use of models to target the most worthy links.

Task 3. Networks and public health: social networks are the spreading medium not only for infections but also for public health messages. Health campaigns and can be devised based on the understanding of the social environment of individuals and their behavioral response to outbreaks and public health emergencies.

Task 4. Networks and evolution: heterogeneity of human interactions is a key factor also in studying the competition and evolution of emerging pathogens. Models are being used to understand the impact of human social behavior on pathogens evolution.

Task 5. Clustered networks: another key issue in understanding epidemic spreading is represented by the effects of clustering on network dynamics related to the number of “triangles” in a human network, i.e. where “a friend of a friend is also your friend”. New methods from probability theory are used in the research work to characterize the effects of clustering on epidemic dynamics.

These tasks have been initiated by four EPIWORK partners with different focuses and emphases. The Tel Aviv group's work on contact networks, for example, was driven by the H1N1 pandemic data they collected. The LHSTM team initiated work on several fronts but devoted much of the first year on their exigent larger scale project "Flusurvey" where contact data was collected across the UK. The data is to be utilized for addressing Tasks 1-5 in the coming years. The work of the four groups is reviewed in more depth here.

The LSHTM team developed models (Task 5) for sexually transmitted infectious diseases (STI's) that focus on the effects of concurrent sexual partnerships (partnerships which have a partner in common), as described in Santhakumaran et al., (2010). These partnerships have been proposed as one explanation for the high prevalence of HIV infection in some countries and modelling studies suggest the presence of concurrent sexual partnerships can increase the rate of invasion of sexually transmitted infections (STIs). They have designed a model of HIV, that describes the dynamics of infection on a clustered contact network. In this instance, there are unusual clusterings, caused by differences in how concurrent partnerships occur in polygynous versus non-polygynous populations, In contrast to conventional wisdom, their study tends to support the hypothesis that polygyny, a specific form of institutionalised concurrency, may be protective against HIV at the population level.

The Bar Ilan University has studied the effects of clustering in networks and its effects on immunization in epidemic networks (Task 5). They use the standard clustering coefficient which gives the probability that two neighbours of an individual are neighbours of each other. They analyse the effect of changing the clustering coefficient on various quantities of interest. In particular, different immunization strategies are studied with different clustered network. As the clustering coefficient of the network is increased, they find that the acquaintance immunization is far more effective than random immunization. A manuscript is in preparation.

The FCUL group has investigated spatially restricted contact networks, namely those with power law distributed connectivity to study super-diffusive spreading (Task 1), as suggested from empirical data of human contact proxies like travel networks and money bill notifications. The influence of such contact networks on epidemic threshold behaviour is investigated (Task 5), especially important for models with reinfection which have besides the no-growth-endemic threshold also further thresholds like the one between SIR and SIS type behavior, namely the reinfection threshold. Several publications have discussed these features (Stollenwerk et al. 2009, Martins et al. 2009, Boto and Stollenwerk 2009).

The TAU group has collected and studied Contact Networks associated with the 2009 pandemic in Israel. During the surveillance efforts, most individuals tested for swine flu were asked by their doctor to identify who they believed they were infected by, thereby providing important information concerning the contact structure of the Israeli population (Task 1,2). Of the 713 cases, 183 (or 25.6%) were able to provide information establishing contact links. The data was used to assemble contact networks which map the connections between an infected person (infector) and the different individuals he/she infected (infectees). The networks are visualized by portraying individuals as nodes in a graph and placing a directed edge from any infector to the individuals he/she infects. The networks thus reveal who infected who. Altogether there were 66 separate infection networks totaling 183 nodes, with 123 links between them. The significant mismatch between number of nodes and links is due to the fact that the networks were largely disconnected with many isolated links. The mean number of outgoing links per network was 0.67. Most nodes - 55.2% had no outgoing links, 33.3% had one outgoing link, 7.1% had two out going links and 2.7 % had three

outgoing links. In addition there were three patients having the status of what might be considered "superinfectors" with four, seven and ten outgoing links respectively.

Theme II: Seasonality and other external environmental drivers

Task 6. Epidemic predictions in seasonally forced systems: the seasonally forced SIRC influenza model with temporary immunity is crucial to gain insight into the non-linear dynamics of the recurring flu epidemics. The work carried on in this task is intended to determine clear analytical conditions for predicting the occurrence of either an epidemic outbreak from one year to another, or a ‘skip’ year – a year in which an epidemic fails to initiate. Mathematical analysis can be used to clarify how the threshold depends on the interplay between the population susceptibility and cross-immunity measured after the last outbreak and the rate at which new susceptible individuals are recruited into the population.

The IGC group study an SIR system of differential equations with periodic coefficients describing an epidemic in a seasonal environment (Bacaer & Gomes 2009). In contrast to constant environments, the final epidemic size may not be an increasing function of the basic reproduction number, R0. Moreover, large epidemics can occur even if R0 is less than unity. These theoretical results should be kept in mind when analyzing data for emerging vector-borne diseases (West-Nile, dengue, chikungunya) or air-borne diseases (SARS, pandemic influenza) influenced by seasonality.

The FCUL group has investigated seasonally forced SIR-type models in influenza relevant parameter regions and show rich dynamic behavior, limit cycles, tori and deterministically chaotic attractors, in wide parameter regions. Adding reinfection to such models contributes to persistence of the disease, as attractors are bounded away from low infection numbers. These analyses are also applied to explicitly multi-strain models, as suggested for dengue fever (Aguiar et al. 2009).

The TAU group has been investigating determinants of periodicity in seasonally driven epidemics. Seasonality strongly affects the transmission and spatio-temporal dynamics of many infectious diseases, and is often considered an important cause for their recurrence. A relatively mild seasonality generally drives epidemic dynamics into annual or biennial cycles, while intense seasonality may be the cause of multiennial or even complex or chaotic dynamics. However, the *underlying* mechanism of these dynamic transitions is still poorly understood. The classical seasonally-forced SIR (susceptible, infectious, recovered) epidemic model gives insights into this phenomena but due to its intrinsic nonlinearity and complex dynamics, the model is rarely amenable to detailed mathematical analysis. Developing a model that closely mimics SIR dynamics, they analytically study the threshold (bifurcation) point where there is a switch from annual to biennial epidemics. They derive, for the first time, a simple equation that predicts the relationship between key epidemiological parameters near the bifurcation point. The relationship shows that frequency of epidemic should increase if either birth-rate (μ) or basic reproductive ratio (R_0) sufficiently rises, but should decrease if strength of seasonality (δ) is strongly enough reduced. These effects are in accordance with empirical observations, and may explain, for example, the correspondence between documented transitions in measles epidemics dynamics and the concomitant changes in demographic and environmental factors such as birth rate. They are currently proceeding with these ideas (Uziel et al.).

Task 7. Demographic and ecological interactions of host populations: Demographic are important when the duration of the disease cannot be separated from host’s like expectancy. The inflow of new susceptibles provides the fuel for ongoing disease transmission. The goal of this task is to identify and review basic mechanisms that induce multi-stability of different endemic prevalence levels and oscillatory disease dynamics. Many diseases are transmitted by animal vectors and involve multiple reservoirs in their life cycle. Modeling therefore will require to address the demography of the vector population as well as its ecology. In the next project periods the research work will begin a systematic classification of these predator-prey models including various pathways of disease transmission.

Theme III. Development of effective intervention strategies.

Task 8. Interventions without contact network knowledge: intervention strategies that are effective when contact information is lacking are tremendously useful. Such strategies invariably require some contact information to become available easily in order to correctly identify the best targets for interventions. In the next period of the research work, strategies based on novel mechanisms exploiting the contact pattern heterogeneity will be developed.

Task 9. Interventions when the contact network is known: in this case, it is possible to globally optimize the strategy to attack the most important nodes in order to stop the spread of the disease.

The Bar Ilan University group has derive an analytical expression for the critical infection rate rc of the SIS (susceptible/infected/susceptible) disease spreading model on random networks. To obtain rc, they first calculate the probability of reinfection, p, defined as the probability of a node to reinfect the node that had earlier infected him. They then derive rc from p using percolation theory. They show that p is governed by two factors: (i) The demand from an infecting node to recover prior to its reinfection, which depends on the disease spreading parameters; and (ii) The competition between nodes that simultaneously try to reinfect the same ancestor, which also depends on the network topology. Understanding the threshold is a prerequisite for determining intervention strategies as the threshold controls the infection free equilibrium.

Task 10. Limiting effective path length: the ability of a pathogen to infect is related to factos specific of the host, factors of the pathogen and the transmission environment. Time variations of some of these factors such as evolution of the pathogen or change in season, represent costraints of the problem and influence the evolution of the epidemic. In the next project period, the effects of limiting the effective path length of communication of some agents such as a pathogen will be studied to improve current estimates of epidemic thresholds in the population.

Theme 4: Models with reinfection

Task 11: Formulate measures of transmission in the presence of reinfection: when reinfection plays a significant role, it has been shown that the knowledge of the epidemic basic reproduction number (i.e. the expected number of secondary infections generated by a single infected individual in a completely susceptible population) appears useless. Recurrent infections are in urgent need of meaningful measures of transmission that can indicate useful targets for the public health interventions.

The IGC group has investigated the effects of the reinfection threshold when heterogeneities, space and stochasticity are introduced (Aguiar et al. 2009, Rodrigues et al. 2009a&b; Stollenwerk et al. 2009, Van Noort et al. 2009). They have noted that heterogeneity in host susceptibility diffuses the transition attributed to the reinfection threshold and recognised that this is essential to reproduce tuberculosis data. They have performed systematic analyses of reinfection models with space and stochasticity, and found clear threshold behaviour at the parameter point where the reinfection threshold was originally described. In spatial stochastic models, the threshold separates annular growth of an epidemic spreading into a susceptible area leaving recovered behind and compact growth of a susceptible-infected-susceptible region growing into a susceptible area.

In diseases caused by antigenically diverse pathogens, reinfection is, to some extent, orchestrated by patterns of cross-immunity between antigenic variants. Research at this level requires refined models where individual variants (or blocks of variants) are represented explicitly. The IGC group has focused on dengue and malaria.

Task 12: Parameter estimation: Influenza will be used as a case study for the validation of the different theoretical developments.

IGC has developed a Bayesian framework for parameter estimation in dynamical models with applications to forecasting which is being applied to data collected by Influenzanet (WP5). This work is described in Coelho et al. FCUL and TAU take advantage of likelihood functions for parameter estimation, as derived from stochastic dynamical models and are compared with numerical schemes of wider applicability. These techniques are applied at the moment to single season Influenzanet data and the Israeli swine flu data (Roll et al.).

Publications and working papers

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WP2
Spatially structured models and human mobility

Lead contractor: Max Planck Institute for Dynamics and Self-Organization

Objectives. The workpackage has three main objectives. first key objective of WP2 is the development of systematic approaches that can identify and quantify modularity in spatially structured and heterogeneous meta-populations and contact networks. The second objective of WP2 is the investigation of human interactions in a network-network duality ansatz. The key goal is to

understand the reciprocal impact of social networks and mobility networks; in other words to what extent are contact networks determined by mobility networks and vice-versa. The third main objective is the use of the above results to advance the understanding of the prediction quality offered by large scale computational approaches and realistic agent based models.

Progress towards objectives. In order to facilitate the communication between and among the partners participating in WP2 a work package specific wiki was set up. On this web-portal the partners can exchange of information, share data, collect work package relevant publications and multi-media content and discuss current research in the field. Also partner specific information is maintained on this website. The WP2 wiki is independent but connected to the global EPIWORK wiki. The reasoning for this encapsulated but informed architecture is to condense information in one location that is relevant to WP2 only. During the past year a number of inter-partner collaborations have been initiated, in particular connected to Theme I of the work package. These collaborative efforts and associated activities are recorded on the wiki for the other partners to see, in order to provide an incentive to join collaborations and strengthen cross-partner interactions.
The research effort of WP2 in the first year was predominantly devoted to various tasks devoted to the understanding the structure of multi-scale human mobility networks (Tasks 1, 2 and 3). The **deliverable D2.1** has been successfully completed. The deliverable consists in a dedicated high performance mysql database server was instantiated. This server manages and maintains large scale databases of records of mobility related data. The server maintains data integrity, is integrated in a backup system and data complies to a developed mobility data syntax. three large scale database have been integrated:

- Proxy data for mobility based on the geographic circulation of bank notes.
- The worldwide air transportation network.
- GPS data on trackable items in geocaching.com.

We are currently in the process of development of GUI and application interfaces though which the database can be accessed by other components of the project, for instance the Epiwork Marketplace. Considerable progress was made concerning the computation of multi-scale community structure and effective geographic borders. Associated with this task wee used a multi scale proxy network obtained from the geographic circulation described above for the United States. In addition to existing methods for community detection in complex networks based on network modularity maximization, The MPG team has developed a new efficient technique based on the analysis of sets of shortest path trees in the network.

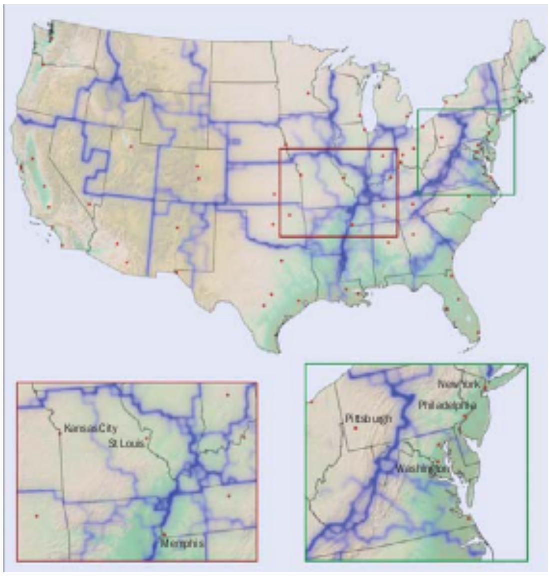

Figure 1: the multi-scale mobility network encodes a hidden structure of effective geographic borders in the US, shown as blue lines on the map

The approach not only permits the geographic identification of locations of effective borders (see Figure below) but also provides a means to quantify their significance and strength. Another ongoing project is clarifying the importance of length-scale in multi-scale human mobility networks. The analysis is based on the proxy network of bill flux as well. Statistical and topological quantities of the network have been analyzed conditioned on the length scale involved. The multi-scale network was spliced into length-scale ranges, the resulting sub-networks were analyzed and statistical and topological quantities computed for each network and subsequently compared. We found that the distributions of link weights, the node capacities and degrees in the sub-networks exhibit strongly different functional form

depending on the length scale involved. This is in sharp contrast to single length-scale mobility networks such as the US air transportation network to which multi-scale mobility networks were systematically compared. The analysis of the effect of multi-scale mobility networks on the analysis of epidemic spreading has been carried out in another project lead by the ISI team. In this work published in the Proceeding of the National Academy of the USA, it is carried out the study of the interplay between small-scale commuting flows and long-range airline traffic in shaping the spatiotemporal pattern of a global epidemic. The research activity consists in the analysis of mobility data from more than 30 countries around the world and the definition of a gravity model able to provide a global description of commuting patterns up to 300 kms. The data have been then integrated in a worldwide structured metapopulation epidemic model in order to evaluate the force of infection due to multi-scale mobility processes in the disease dynamics. The obtained results outline the possibility for the definition of layered computational approaches where different modeling assumptions and granularities can be used consistently in a unifying multi-scale framework.

Publications and working papers

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WP3
Information Platform

Lead contractor: Faculty of Sciences University of Lisbon

Objectives. This workpackage develops the Epidemic Marketplace, Epiwork's information integration platform, the environment where epidemiological data can be stored, managed and made available to investigators, fostering collaboration. The objectives of Epiwork where the Epidemic Marketplace will have a direct impact are: (1) the development of large scale, data driven computational models endowed with a high level of realism and aimed at epidemic scenario forecast; (2) the design and implementation of original data-collection schemes motivated by identified modelling needs, such as the collection of real-time disease incidence, through innovative Internet and ICT applications; (3) the set up of a computational platform for epidemic research and data sharing that will generate important synergies between research communities and states.

Progress towards objectives

The work package activities have proceeded and the deliverables planned for the first year have been completed on time, despite the difficulties in hiring the people initially envisioned to conduct the development tasks at the University of Lisbon, Faculty of Sciences. We expect to recover the delays that this caused to the project and use the non-spent personnel budget in the coming years. The two deliverables have been completed on time, despite these difficulties, albeit the functionalities that we have at this time are not as comprehensive as expected. However, we decided that it would be better to make the existing prototype available to the consortium than delaying its announcement.

Task 1: Data collection. Realistic simulations of epidemic processes crucially depend on the availability of datasets describing human behaviour and pathogen-host interactions. Datasets include population movement data, social and behavioural data, health related data, geographic data, detailed geo-temporal epidemic incidence and immunization data, pathogen evolution and multi-strains circulation data. Data can come from a variety of different sources, including hospital records, country statistics, Web content, and others. It can range from a global scale, such as the worldwide air transportation infrastructure, down to the detailed description of individual activities at a minute-by-minute scale. This task is creating a catalogue of databases of epidemiological data across Europe, with extensive meta-data describing the main characteristics of the available information sources. The data collection activity by the consortium started at M13, after the deployment of first functional prototype and its release to the consortium (**Deliverable D3.2**). In the first semester, we started with some initial experiments, including:

- Initial catalogue design, i.e., initiated the conceptual model for managing large datasets that is now under development.
- Design and implementation of a data collection prototype based on the twitter API and development platform (flu-related tweets).

In the second semester, we initiated the development of a second prototype of a data collector and the development of an initial prototype of the Epidemic Marketplace services.

Task 2 : Meta-model design. The Epidemic Marketplace Platform supports the sharing and management of epidemic datasets and resources as well as their rating, annotation, and selection. Each dataset will come with a metadata file, signalling the date of submission, the last update, the source of the dataset, a basic profile (e.g., transportation network – Origin-Destination matrix), and a more thorough description of the dataset and the classification used. Work in this task, most of it detailed in **Deliverable D3.1,** included:

- A review of meta-modelling techniques and existing standards.
- Characterisation of the data sources most commonly used in epidemiological studies.
- Initial design of the epidemic meta-data catalogue.

In October 2009, we initiated the development of an Epiwork meta-data editor for epidemic datasets, following the policies outlined in deliverable D3.1.

The activity on Task 3: Epidemic Marketplace Platform has progressed towards the implementation a platform based on the integration of grid technology and publicly available services and software on the web to support the sharing and management of epidemic datasets and resources as well as their rating, annotation, and selection. Researchers can use and contribute to the Marketplace in several different ways. They can: (1) use it as a catalogue of data sources containing the metadata describing existing databases; (2) view, download, tag, and comment on the available resources; (3) provide compliant datasets and relevant information; (4) use it as a forum where to publish information about their own data, seek modellers to collaborate with, share and distribute their new findings. Progress in this task in the fist year included:

- Definition of the general architecture of the Epidemic Marketplace. This has involved joint discussions with WP5 on how data collected data by IMS in different countries is aggregated in datasets and uploaded to the Epidemic Markeplace. Privacy and anonymization issues have emerged.
- Infrastructure design and identification of equipment to be acquired for Epiwork.
- Installation of the hardware and base software (OS)
- Configuration and implementation of fault tolerance support for the epidemic marketplace: backup and data replication policies

- EM services installation, including Epidemic Marketplace's Repository main components: Fedora Commons (www.fedora-commons.org) and Muradora (http://www.muradora.org/muradora). The Repository is now accessible to authenticated users from http://epiwork.di.fc.ul.pt/muradora/
- Deployment of a first prototype version of the Epidemic Marketplace Forum, based on phpBB, http://www.phpbb.com/.

The first operational prototype of the Epidemic Marketplace was presented in the November 2009 meeting in Torino, and made available to Consortium members since then from http://epiwork.di.fc.ul.pt. In January 2010, we initiated the deployment of a new version of the EM base software, to be based in Fedora Commons version 3.0 and the Drupal Content Management System. This new version will substitute the current, based of Fedora Commons v2.0 and Muradora.

- Discussions with partners involved in WP3 on how to identify relevant datasets to the catalogue and strategies and incentives for populating the Epidemic Marketplace.

The activity on Task 4: Evaluation and monitoring of the use of the catalogue and collaboration services was not scheduled to start in the first year. Evaluation work is to take place only once the information platform is deployed.

Publications and working papers

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WP4
Epidemic Modelling Platform
Lead contractor: ISI Foundation

Objectives. The project foresees the design and implementation of an *Epidemic Modelling Platform*, made available to a wide range of users through the Web. Modelling algorithms developed in WP1 and WP2 will be interfaced with the relevant data available from the information sources listed in the Epidemic Marketplace Platform developed in WP3, with the aim of providing a simulation platform for several distinct infectious diseases and granularity scales of the system. Newly developed visualization techniques will be embedded in the platform to provide access and understanding of the simulation results.

Progress towards objectives

The workpackage activities have proceeded a faster than expected pace because of the H1N1pdm. All groups involved have accelerated the work on the various tasks defined in the workpackage. In particular considerable progress has been made on:
Task 1: Data integration into modelling algorithms. The activities have been accelerated by the need of providing realistic simulations and scenarios at the early stage of the H1N1pdm. All groups have been worked in integrating new data sets at various resolutions. The ISI, FBK and MPG groups

have gathered data from various sources of proxy networks, the census bureau of 40 countries in 5 continents and collected detailed data on the socio-demographic structure (e.g., age-structure, frequencies of household type and size, employment rates) of European population as provided by the Statistical Office of the European Communities (Eurostat) and integrated with data provided by the National Statistical Offices for countries not covered by Eurostat. Along those data, data at the worldwide scale concerning multimodal transportation have been collected and cured for their integration in the simulation softwares. The data have been integrated in both the large scale a stochastic, spatially explicit, individual-based simulation model developed by the FBK team and the Global Epidemic and Mobility model platform developed by the ISI team.

Task 2 : Data and simulation results visualization. The need to communicate the results obtained during the H1N1pdm from the data platform and the data driven simulation results have pushed the propelled in the development of visualization techniques. ISI has created a GUI with automated geographical mapping of the results obtained with the simulation software. This interface is one of the component of the general computational platform and it is already interfaced with the GLEaM software. The FBK team has started to improve modularity of its ABM modeling approach by using database for storing parameters and output by integrating GIS visualization tools. The communication of the monitoring infrastructure results has progressed by the development of visualization mapping and algorithm specifically designed to communicate results at the wider audience formed by public users of the platforms. All the results developed toward this task are contained and detailed in the **deliverable D4.1.**

The activity on Task 3 : Epidemic Modelling Platform has progressed with the design of a client-server architecture tailored for the implementation and control through an appropriate GUI of the epidemic simulation software. At the moment the implementation is wrapped around the Global Epidemic and Mobility software that will be the first simulation tool to be incorporated in the platform. The work is however proceeding in the study of techniques to integrate different simulation approaches at once. This has led to the study of techniques to align parameters and initial condition in different modeling approaches. This joint work between the ISI and FBK teams is the first side by side comparison of large scale structured metapopulation and agent based modeling approaches. It shows promising avenues for the implementation of quantitative approximation schemes which calibrate the level of data resolution and the needed computational resources with respect to the accuracy in the description of the epidemics.

The research activity focused on Task 4 and Task 5 (Data-driven simulations for case studies analysis and epidemic forecasts: national scale; international scale) has acquired unprecedented momentum in view of the H1N1pdm unfolding. The FBK, ISI and MPG teams have been used different simulation and computational approaches to provide real time, quantitative analysis of the spatial spreading of the pandemic. Most of this work has been performed in close contact with national and international agencies, taking active part to the international effort aimed at minimizing the impact of the pandemic in the world.

The FBK developed a stochastic, spatially structured individual-based model, considering explicit transmission in households, schools and workplaces, to simulate the spatiotemporal spread of an influenza pandemic in Italy and to evaluate the efficacy of interventions based on age-prioritized use of antivirals in terms of cumulative attack rate and excess mortality reduction under different scenarios. Results suggest that governments stockpile sufficient influenza antiviral drugs to treat approximately 25% of their populations. In countries with limited antivirals stockpile, providing prophylaxis to younger individuals is an option that could be taken into account in preparedness plans. In countries where the number of antivirals stockpiled is well below 25% of the population, priority should be decided based on age-specific case fatality rates. However, late detection of cases

(administration of antivirals 48 hours after the clinical onset of symptoms) dramatically affects the efficacy of both treatment and prophylaxis. (academic paper published on BMC Infectious Diseases). The FBK team has then extended the model to the entire European populations leveraging on the integration of air and railway transportation data. The analysis has shown that the impact of the epidemic in the European countries is highly variable because of marked differences in the socio-demographic structure of the European populations. R0, cumulative attack rate and peak daily attack rate depend heavily on socio-demographic parameters, such as the size of household groups and the fraction of workers and students in the population (academic paper published on Proceedings of the Royal Society B).

The MPG team employed performance computational techniques and multi-layer, large-scale computer simulations to project the time course of the H1N1 flu epidemic in the United States. The simulations yielded projections and risk assessments of the epidemic outbreak in a worst-case scenario, in which no containment measures are taken to mitigate the spread. The approach was based on the current knowledge of the disease parameters and took into account the backbone of spatial spread: A precise estimate of human mobility on spatial scales between a few and a few thousand kilometers. The projections resolved the expected dynamics down to the county scale (3,109 counties in mainland United States). Details of our modeling approach are not yet published but are available online at http://rocs.northwestern.edu.

The ISI team have been using the Global Epidemic and Mobility (GLEaM) model to to provide real time forecast on the unfolding of the H1N1 epidemic worldwide. This modeling effort has been unique as it has been the only one attempting to obtain quantitative results worldwide. The necessity to provide new way to obtain real estimates for the disease parameters have pushed the team to work on a new methodology that perform a likelihood analysis of the model with respect to chronological data of the diffusion processes. This methodology allowed us to obtain early estimates of the transmission potential of the H1N1 virus by taking advantage of the multi-scale diffusion processes defined by the population mobility networks. This is the only model coupling countries worldwide and this feature is extremely relevant in evaluating the time pattern of emerging infectious diseases. For instance, given a set of initial conditions for a local outbreak of new strain of influenza, the timeline of the arrival of the epidemic in each country and the ensuing activity peak is mainly determined by the human mobility network that couples different region of the world. By looking at individual countries in isolation, any estimate of the epidemic timeline is going to be based on assumptions about imported cases from the rest of the world. GLEaM instead has built in the human mobility that allows to consistently simulate the mobility of infectious individuals on the global scale thus providing ab-initio estimates of the epidemic timeline in each country or urban area without assumption on mobility and case importation. The model has been used to provide short-term predictions of the early unfolding of the epidemic in the USA and Europe.

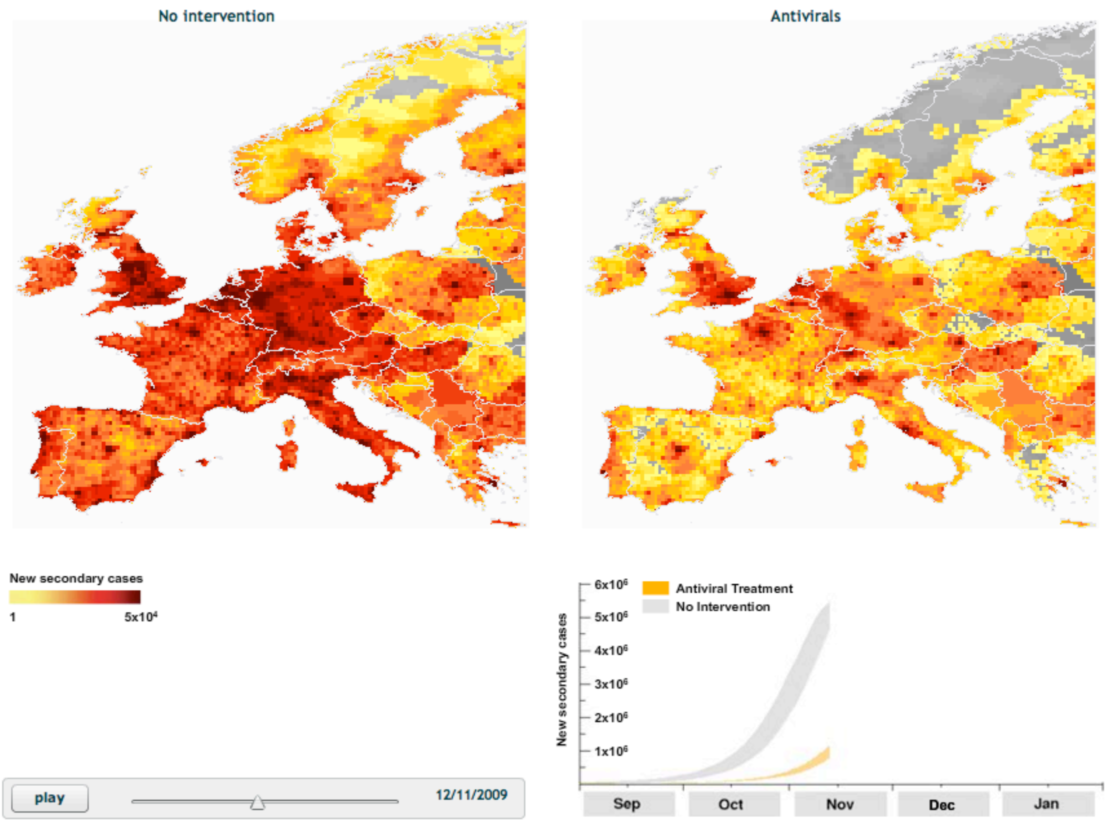

Figure 2: snapshot from an animation showing the daily new number of cases calculated on 2,000 stochastic realizations of the model, for two scenarios: no intervention and anti-viral treatment

The results for the US have been found to be in very good agreement with the approach by the MPG team, thus providing evidence that the modeling strategies proposed in this project offers stable and consistent results. The obtained results have been also validated with a posteriori analysis with the real data collected by the CDC in the months of May and June. The agreement between the predictions and the actual unfolding of the pandemic has been proven to be remarkable. The GLEaM approach has then been used to provide in the month of June and July long term prediction of the occurrence of the epidemic activity peak in the Northern hemisphere countries in the winter.
The method anticipated an early peak occurring in October/November in most of the countries. The predictions, of a quantitative nature (peak week and relative 95% reference range), have been published in early September on BMC Medicine. This is the only paper so far that has attempted a quantitative forecast of the activity peaks. The predictions contained in the paper have been validated against the real data provided by agencies of more than 40 countries. The results show a very good agreement between predictions and real data with offset of at most two weeks. These findings provide a strong and remarkable test of the quantitative level of the prediction offered by computational methods. The GLEaM model has been used also for the analysis of vaccination campaigns, the backtrack estimates of the actual number of cases in the Mexico, the projections for ICU occupancy and antibiotic usage. All papers have been published in disciplinary journals (see list below). The work done in this work package has to be considered as a major breakthrough that has shown for the first time, in a real world situation, the potential of computational methods in providing anticipations and forecasts that can be used in the support of the policy making and public health decision-making processes.

Publications and working papers

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- M. Ajelli and S. Merler. An individual-based model of hepatitis A transmission. Journal of Theoretical Biology, 259(3):478-488, 2009
- P.Bajardi, C. Poletto, D. Balcan, H. Hu, B. Goncalves, J. Ramasco, D. Paolotti, N. Perra, M. Tizzoni, W V. den Broeck, V.Colizza, and A. Vespignani, *Modeling vaccination campaigns and the Fall/Winter 2009 activity of the new A(H1N1) influenza in the Northern Hemisphere.* Emerging Health Threats Journal. **2**, e11 (2009).
- D. Balcan, H. Hu, B. Goncalves, P. Bajardi, C. Poletto, J.J. Ramasco, D. Paolotti, N. Perra, M. Tizzoni , W V. den Broeck, V.Colizza, and A. Vespignani, *Seasonal transmission potential and activity peaks of the new influenza A(H1N1): a Monte Carlo likelihood analysis based on human mobility."* BMC Medicine, **7** 45. (2009).
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WP5
ICT monitoring and reporting systems
Lead contractor: Acquisto Inter BV

Objectives
WP 5 is meant to provide validated data through innovative ICT applications, in particular the internet-based monitoring system or IMS with its public internet name: Influenzanet. The key objectives of WP5 are:

- Introduction and implementation of the IMS into five 'new' IMS countries: Sweden, UK, Germany France and Spain, from 2010 to 2013.
- Extension of IMS data collection by mobile phones
- Extension of IMS with schemes for monitoring infectious and allergic diseases
- Extension of IMS with data on contact patterns
- Well operating, renewed IMS in nine European countries in 2013

Progress towards objectives

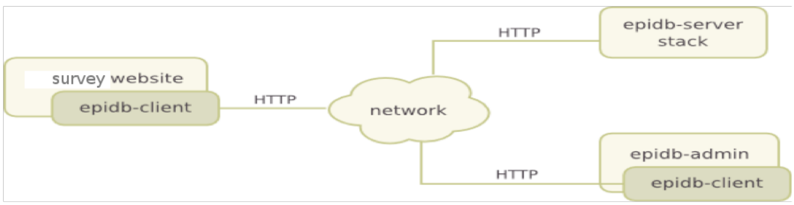
The surveillance activities of the already existing platforms have been intensified in the Spring 2009 because of the H1N1pdm. All groups in the several countries where the IMS were not yet active, have accelerated the work and pushed forward the implementation of the surveillance system to start collecting data in real time during the newly announced pandemic. In particular, in the UK the IMS has been deployed in the early Summer of 2009 (http://flusurvey.org.uk), well ahead of

schedule. The platform has been collecting data on Influenza since July 2009. Information is currently being collected from over 5500 participants across the UK.

Task 1 (‘Gold standard’ of ILI symptoms): this task is crucial for the project’s aim of gathering cross-country surveillance data that do not suffer from national-related biases and methods. The discussion among the partners has been brought forward by the need of having an appropriate survey best describing the different countries requirements in the data collection method during a public health emergency period. The first draft has been developed in July, the second draft has been tuned in August 2009, before the striking of the Autumn wave of H1N1 pandemic.
WP 5 Partner KULeuven was involved in the task for the first year to optimize uniform ‘gold standard’ questionnaires for all project-related internet-based monitoring systems (IMS). These ‘gold standard’ questionnaires not only distinguish influenza-like diseases, but also common colds, gastro-enteritis, and hay-fever. The questionnaires have been evaluated by all the partners involved and by 1st year bachelor medicine students of the Albert Einstein College of Medicine (Yeshiva University), New York, USA. After the adaptation of the comments of these students, a final version of the questionnaires has been proposed to all partners. See **Deliverable 5.1** for more details.

Task 2 (General outline and implementation of *European IMS database infrastructure* and website (single centralized database, design of templates for the website in five new local versions): already during the early phases of the H1N1 pandemic, database contents of the already existing local IMS platform have been collected in a centralized repository that provided an extensive source of epidemiological data. During the first WP5 meeting (25-26 May 2009) in Amsterdam and Epiwork project meeting (15-18 November 2009) the discussion among the partners has led to the preparation in December 2009 of a draft for the design of the European centralized database, again brought forward by the occurrence of the H1N1 pandemic. The presentation will be in March 2010, well ahead of schedule. The database will provide easy-to-access, reliable, uniform and standardized epidemiological data. Database contents of the local IMS will be consistent and have standard cross-country information.
AIBV and its subcontractor UvA carried out the design and implementation of the European IMS database in different phases, ranging from the identification of purpose and scope and requirements analysis through the logical design of the software stack to the conceptual and physical design and implementation.
They elaborated, developed and implemented a four-component architecture:

- epidb-server: the part of the complete server infrastructure that receives and processes data.
- epidb-client: a programming library (python, php) to access the epidb-server.
- epidb-admin: a remote server administration client.
- survey website: the survey website package.



In parallel to this activity, the content update of the IMS platforms and a new website design process for the first Influenzanet website has been started. This new web infrastructure has been

designed to deploy the local IMS in the several countries participating to the project, both new and existing. The design of the new IMS templates is crucial to provide research teams with an easy access to surveillance data not hampered by problems related to different standards, different languages, different accesses to computational and storage facilities across country borders. The idea was to use a new, modern design as a basis for all nine Influenzanet websites. Three designers presented their concepts before the WP5 meeting of 25 and 26 May in Amsterdam. The joint assembly of WP5 partners made a first selection, after which two designers worked out their ideas.
The selected one is the new lay out since October 2009 of the Dutch-Belgian site (see details in **Deliverable 5.1**). All partners will apply this website framework for their own, national websites, with local variations according to their own wishes. An international website with content in the English language will be launched in March 2010, when the European database is tested and ready. The international Infleuzanet.com website will be based on the current design, with a focus on the European activities, including a map of Europe and with special attention to the epidemic and modelling research within the Epiwork project. It is predominantly meant for the interested lay audience.

Task 3 (Design and implementation of an internet database with English language documents):
All educational documents in Dutch have been either updated, completely reworked and/or added as new, up to date documents on flu and vaccination. This includes school methods and information material for all ages, from the very young to +18 years and adults. See: www.degrotegriepmeting.nl/?thissection_id=23. These documents are crucial to attract visitors to the Influenzanet websites willing to contribute to the surveillance by filling in the single and extended intake and the compact, weekly questionnaires. They include:

- A professional marketing strategy, including an active press approach via press messages and networking among journalists, and a range of services for schools and interested laymen;
- The provision of 'reader ready' information and educational material or for the lay audience and the school children and their teachers.
- An up to date website, with a country map showing the 'flu-state-of-affairs' and providing news and accessible information on flu and cold, vaccination, health care and scientific research;

(see details in **Deliverable 5.1** and **Milestone 5.1)**. All material can be viewed and used on line. Most lessons are interactive and free to download. All on line material will be placed at the new European Influenzanet website with an European database from Task 1 (March 2010).

Task 4 (Local coordination in the 'old' IMS countries, Netherlands, Belgium, Portugal, Italy and in the 'new' IMS countries: Sweden, UK, France, Spain and Germany). The collaborative aspects of the WP5 have been further amplified by the occurrence of H1N1 pandemic influenza. The pilot phase of IMS in the new countries, foreseen for the winter season 2010/2010, was forcedly anticipated. As mentioned above, the IMS was deployed in UK in the early summer of 2009, thanks in particular to the joint effort of the UK, Portuguese and Italian teams. Sweden will follow in 2010 and Germany, France and Spain from 2010 – 2012 (Task 5 and Task 6: Testing and Implementation of the IMS in the five new countries starting in 2010, foreseen for the next three years).
The UK IMS (www.flusurvey.org.uk) has been collecting data on influenza since July. The implementation of this was brought forward due to the H1N1 pandemic. Information is currently being collected from over 5500 participants across the UK (making the UK survey the third largest survey within the network). Hence implementation of this was ahead of schedule. Two papers are in draft form from the results of the ICT monitoring during the pandemic of 2009. The first documents changes in the way individuals accessed treatment over the course of the H1N1v epidemic. Importantly, there were major changes in access to health care during the epidemic, with

individuals being far more likely to contact health services during the early part of the epidemic than later on. This was partly because in the National Pandemic Flu Service (NPFS) was introduced (a service that allowed individuals to collect antivirals without visiting a general practitioner). This highlights the utility of this internet-based collection methods, as all traditional forms of data collection require individuals to contact the health service in some way. If individuals change the way they access health services (which is evident from the data collected by flusurvey – Figure 1), then the traditional surveillance data will be biased. The ICT allowed the UK to monitor and correct for this bias in the epidemic in real-time.

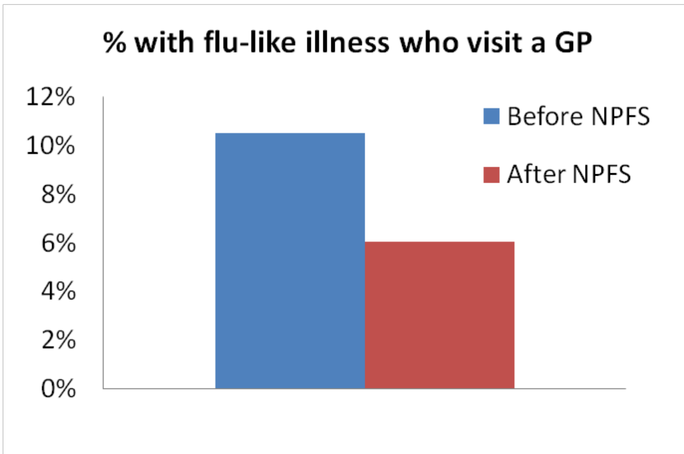


Figure 1. Changes in the fraction of individuals contacting their GP after the implementation of NPFS.

The data from the ICT monitoring system were used to inform pandemic-related decision-making in the UK on a range of topics from the period of absenteeism to the physician consultation and hospitalisation rates. John Edmunds is a member of UK Government's pandemic scientific advisory committee, and the results from flusurvey were used to inform the modelling committee on epidemic progress and changes to access care patterns etc, during the epidemic. The data were also used to inform a real-time model of pandemic influenza in the UK and an associated economic evaluation of alternative vaccination policies. This paper will shortly be available (proofs attached).

Moreover, WP5 partner FGC-IGC developed a platform that downloads daily the latest data from all Influenzanet systems and converts those different data formats into one standardized format. Based on all current and historical Influenzanet data, various data representations are daily generated and presented online, including interactive maps, incidence curves, comparison with other data streams such as Google Flu Trends and EISN, ILI activity in subgroups and activity of other symptoms. The website also provides the option to download the latest Influenzanet data, as well as various other information about the system such as the questionnaires and the publications. The website is currently in a beta stage on http://beta.influenzanet.com/ but will soon be available on http://www.influenzanet.com/.

They also have confirmed the consistency of the Influenzanet system over its 7 years of existence in four different countries by applying linear regression model on Influenzanet data and EISN data and Google Flu Trends data, respectively. They have identified individual variables associated with increased risk of ILI, by applying logistic regression models to explore the association between individual and household-level covariates and the occurrence of at least one ILI episode during a flu season, In the Influenzanet cohort, having diabetes or asthma, living with a child, being female, belonging to young age group, and being a heavy smoker, were all independent predictors of the risk of having at least one ILI episode during a flu season. These findings are in line with the influenza literature. They are analyzing the change in risk factors during the pandemic flu season

(2009-2010), as well as the chances in symptoms associated with ILI. (A manuscript is in preparation).

Task 7 (Development and Implementation of innovative non-intrusive data gathering solutions, based on the use of mobile phones):
One direction that will be pursued in order to involve larger fractions of the population in the data gathering process, is to extend existing reporting tools to a mobile environment, this considering mobile platforms such as, e.g., smart phones, PDAs, netbooks, as candidate platforms for running a mobile extension of the IMS. Mobile phones are nowadays becoming the most widely diffused platform, with the 100% penetration barrier already passed in various European countries. Mobile phones are then the natural candidate platform for implementing a Mobile Internet-based Monitoring System (MIMS), the mobile version of the IMS monitoring system application. The usage of mobile phones is expected to provide access to the project for a much larger fraction of the population, and in particular to the people who do not access the web on a regular basis. In addition, the mobile application is expected to facilitate and, possibly regularize, the data provisioning also for users that are already using the IMS.
During the first year of activities WP5 partner CREATE-NET have completed the analysis and design of the platform. The results of this activities were presented during the WP5 meeting in Amsterdam (5/6 May 2009). In particular, a complete requirement analysis has been performed, along with the design of Epiwork Mobile infrastructure, the design of Epiwork Mobile Application Software and its impact analysis. In parallel, WP5 partners CREATE-NET and ISI have worked on an attitude survey that was presented to the Influweb (the Italian IMS) users in order to understand the key factors motivating people to participate to these symptoms reporting campaigns. Finally, a basic prototype of the platform has been developed and used for some preliminary tests.

Task 8 (Development of Software for contact patterns detection): the main objective of this task is to collect the contact pattern data of users. Contact pattern data will provide information about the duration and frequency of contacts with other persons. In order to enhance models with realistic contact patterns and provide information on the 'social attitude' of users, CREATE-NET, AIBV and ISI started in May 2009 to cooperate with Dr. Ben Reis from the Harvard Medical School (Boston, US) on the implementation of a social data gathering application. At the first WP5 meeting in May 2009, Dr. Reis presented his experience in developing healthcare applications over the Facebook platform, thus exploiting the power of social networking to engage a wide number of users into a healthcare application. In particular, he reported on Healthysocial (http://www.healthysocial.org/), a Facebook application for running health surveys and for promoting healthy behaviour. During the meeting in May, we agreed to collaborate in order to adapt the existing health-social application to the requirements of the EPIWORK survey, and to jointly launch the initiative during the 2010 winter season. The work was completed by December 2009, with the platform being ready in English, Italian and Portuguese. A Dutch version is about to be finished. The official launch of the application is about to happen, along with the preparation of the media campaign that will be used to advertise the launch. Most of the costs are working hours, covered by Dr. Reis and his team. AIBV will soon sign a subcontract with the Harvard Medical School on the coverage of graphics and editing of the Facebook Influenzanet application.

Task 9 (IMS extension for surveillance of other than influenza contagious diseases). An internet monitoring system based on questionnaires regarding specific allergy symptoms and diarrhoeal infections will be developed and implemented in Portugal in the next few months. This extension of the present IMS is expected to start collecting data in Fall 2010.

Task 10 (Gathering of contact pattern data in addition to the IMS / Influenzanet in the UK):

WP 5 Partner LSHTM developed and implemented an Internet based contact pattern questionnaire as part of the IMS and delivered it ahead of schedule. By Jan 2010 over 8,500 different diary entries have been recorded. Over 1000 individuals have filled out the survey on more than one occasion, and over 200 users (about half the regular Flusurvey participants) have filled out the survey on 12 or more occasions. The survey therefore appears to be well tolerated by participants.
The survey has enabled researchers to track changes in contact behaviour over time, and associate this with changes in school holiday periods. Results show that school holidays affect contact patterns, with a reduction in the number of contacts made by participants during these periods. The UK epidemic appears to have been driven by these changes with the initial epidemic in June and July being curtailed once schools closed at the end of July, and resumed again in September, once schools re-opened. Flusurvey gave us the only prospective measure of these contact patterns in real-time. The largest changes that occur during school vacation time, occur amongst children. Children reduce their number of contacts by about 1/3rd during vacation periods, mainly as a result of changing their rate of contact with other children. As we are also recording, prospectively, self-reported influenza-like-symptoms we are able to estimate the role of different sorts of contact and with different individuals on the risk of developing influenza. For instance, contact with children appears to be a significant risk factor, whereas the use of public transport does not seem to be associated with acquisition of influenza. See **Deliverable 5.2** for more details.

Publications and working papers

- Godinho A (2009) *Epiwork: Developing the framework for a European forecast infrastructure*. Research Review Magazine 9: 49.
- Friesema IH, Koppeschaar CE, Donker GA, Dijkstra F, van Noort SP, Smallenburg R, van der Hoek W, van der Sande MA (2009) *Internet-based monitoring of influenza-like illness in the general population: experience of five influenza seasons in The Netherlands*. Vaccine 27:6353-7.

WP6
Reporting systems comparative analysis and validation

Lead contractor: The Swedish Institute for Infectious Disease Control

Objectives

The overall objective of the work produced within WP 6 is to provide a comparative analysis of three systems for disease surveillance in Sweden: (1) the existing General Practice-based sentinel system of influenza surveillance with the (2) new internet monitoring system (IMS) that is implemented within the framework of WP 5, and (3) a new population-based approach (PBA), recently developed and evaluated at the Swedish Institute for Infectious Disease Control (Smittskyddsinstitutet – SMI).
A fundamental prerequisite for surveillance-driven modelling is that are surveillance data on incidence rates in important substrata of the population, defined in terms not only of geography and simple demographics features (age, sex etc) but also of socio-economic structure related conditions such as education, occupation, household size, housing, commuting habits etc. Even more important is to show that these rates are valid, i.e. to ensure that incidence rates are obtained in a representative sample of the population. Sweden, with its efficient population administration offers exceptional opportunities to obtain representative samples of the population. By performing a truly

population-based disease surveillance (in a random and controlled sample of the population) in parallel with the IMS surveillance program, it will be possible to shed better light on the issue of systematic errors in the rates. This will add to the validation of the IMS and may permit future calibration of the IMS data.

Progress towards objectives

Task 1 (To obtain ethical approval for the IMS and PBA surveillance. Implement the IMS in Sweden): due to the intervening new influenza pandemic that emerged during the spring of 2009, the set-up and implementation of the PBA was expedited. Therefore, the ethics approval was obtained already before the end of the summer 2009. The preparation for the launch of the IMS surveillance system has proceeded as planned. Since the primary storage of the reports generated within this system will take place in a central server in Amsterdam, a continuous dialogue has been held with the Swedish Data Inspection Board. Both ethical and legal issues are considered solved. A plan for the marketing of IMS website has been established, and collaboration has been established with WP5 partners, notably the contractors responsible for the software stack and the data storage and processing.

Task 2 (To reach a business agreement with the subcontractor that provides the telecommunication and computer infrastructure for the PBA. To set up the Interactive Voice Response telephone system, the secure website, the response database, and the reporting system): the agreement with Linewise, an IT subcontractor small business was obtained before the end of the summer 2009.In collaboration with researchers at SMI and the department of Medical Epidemiology and Biostatistics at Karolinska Institutet (MEB/KI), Linewise has built and tested the reporting system, including the Interactive Voice Response telephone service, the secure website, and the response database.

Task 3 (To reach a random sample of the Stockholm population and approach the selected individuals with invitations (and reminders) via regular mail (recruitment of the PBA cohort)),
task 4 (To administer the PBA system during 12 month, including activities aimed to keep up the participants' attention to the study),
task 5 (To send out and collect postal or Internet-based validation questionnaires about the occurrence of infectious disease symptoms in the previous week):

A fully functioning technical infrastructure for the PBA surveillance was up and running in early September 2009, well ahead of schedule. A representative reporting cohort has been established through random sampling of approximately 5,000 individuals (all ages) selected from the complete and continuously updated population register (see details in **Deliverable 6.1** and **Milestone 6.1**).
The PBA results in regard to influenza-like illness (ILI), as displayed on the website of SMI (http://www.smittskyddsinstitutet.se/publikationer/smis-nyhetsbrev/sjukrapport) has shown that the incidence of ILI was on the rise in week 40 (last week of September). It peaked in week 43 (third week of October) with an overall incidence of 980 per 100,000 person-weeks. This is lower than the peaks observed for the two preceding seasons. Yet,
According to the Task 6 (To clean the datasets and to compare data obtained through IMS, PBA and reports from the sentinel GPs and laboratories) a comparison with traditional surveillance data has been made: data from the existing General Practice-based sentinel system of influenza surveillance indicated an incidence of 8.7 per 100,000 person-weeks, which was quite evidently a gross underestimation, because only a small fraction of all diseased persons consulted health care (in fact, the public had been exhorted to refrain from consultations unless the disease was serious), and since the denominator for the sentinel data can be no more than a conjecture. In week 47 (third week of

November), a sharp decline in the incidence began. A similar decline was noted also in other European countries, albeit it began 1 or 2 weeks earlier.
Interestingly, further data analysis shows that the peak was driven to a large extent by children and their parents age bracket (15-39 years). In the youngest age group, the peak incidence was well above 2000 per 100,000 person-weeks. In middle-aged and old people, on the other hand, the incidence was considerably lower and declining. This pattern is in good agreement with qualitative reports from the Stockholm schools and from the sentinel reporting system. Thus, the data from the PBA was quite reasonable, and in terms of numbers much more reasonable than the existing sentinel reporting. These data have been extremely helpful in SMI's monitoring of the pandemic. Interestingly, a steep increase was noted among the youngest participants in the most recent week. Whether this is an indication of a "second wave" of the new influenza, a new outbreak if the annual influenza, or "spill over" from an increasing incidence of other acute respiratory infections requires further analyses. Efforts to validate the PBA are already in progress. Criterion validity is studied using concurrent postal questionnaires that inquire about disease onsets in the previous week.
Moreover, we have developed the questionnaire about contact patterns and other possible determinants for increased or decreased risk of disease transmission. It will be presented electronically at a secure website with personal log-in for participants with whom we have established electronic contact (i.e., those who have provided an e-mail address). For the remainder, a paper questionnaire will be sent out by regular mail, and the responses will be computerized through optical scanning. In the PBS, the questionnaire for children, whose parents serve as proxy reporters, differs somewhat from that for adults, in particular with respect to the detailed questions about number of contacts by type (conversation, physical contact, long and short duration) and categories of people (new contacts, previous acquaintances, children, etc). Instead, information on the size of day-care groups, classes, etc, and the number of adult attendants will be sought. The questionnaire will be administered already to the present cohort, in order to, inter alia, confirm the feasibility of this component when applied in full scale.
To further increase the discriminative value of the self-reported symptoms, which form the basis for the classification of disease events as influenza (or rather influenza-like illness) and other acute respiratory infection, we are presently conducting a study nested within the ongoing "sentinel testing" initiated by the SMI. In sentinel testing, participating general practices and hospital outpatient departments perform viral testing on outpatients with upper respiratory tract symptoms regardless of whether they are influenza-like or not. The patients fill out a rather comprehensive questionnaire about symptoms and signs. With the virological diagnosis as gold standard, a prediction ruler is being developed in a subset of these patients. It will subsequently be tested in another, independent subset.

Publications and working papers

The first publication, studying the comparability of data generated with Internet-based reporting and data from Interactive Voice Response telephone contacts, is presently under review at an epidemiological journal:

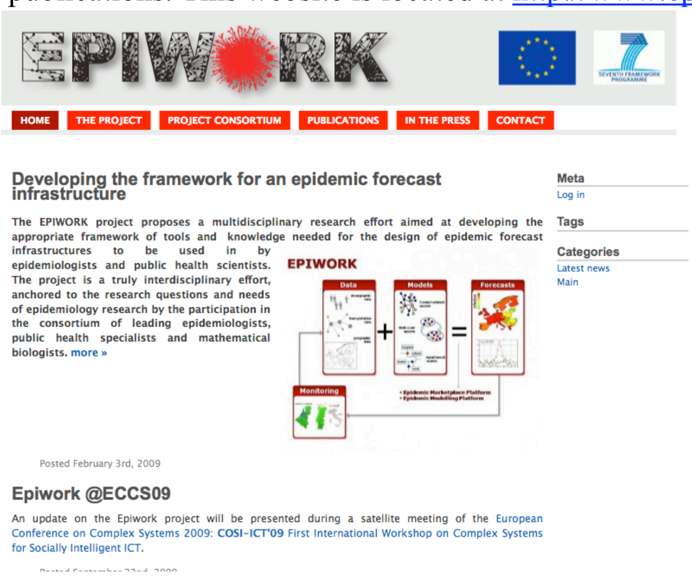
Bexelius C, Merk H, Sandin S, Nyren O, Kühlmann-Berenzon S, Linde A, Litton JE. *Interactive Voice Response and web-based questionnaires for population-based infectious disease reporting*.

WP8
Dissemination, collaboration and exploitation
Lead contractor: ISI Foundation

Objectives. The goal of this work package is to make sure that the results achieved by the project are widely disseminated and can constitute the basis of other research across the scientific and engineering communities. The WP will also supervise the joint collaborative efforts with similar FET projects and the proactive FET initiatives and projects on science of complex systems for socially intelligent ICT. This WP will also ensure the delivery of the annual Dissemination, collaboration and exploitation report.

Progress towards objectives
The WP package has been extremely successful in coordinating and promoting outreach and dissemination activities as well as establishing contact with agencies and institutions aimed at maximizing the social impact of the project.

- The H1N1 pandemic event has fostered the development of collaborations among most of the national institutes of Health of the countries represented in the consortium. The project has been constantly in touch with the ECDC during the year and specific collaborations have been established with the Joint Research Centre of the European community in the area of computational modelling for the anticipation of pandemic crisis.
- The consortium has prepared a project presentation accessible to the non-specialist. The project presentation is available on the web site and distributed at various events where Epiwork has been attending and constituted the first deliverable of the project (WP8: D8.1). The ***visual identity*** of the project has been defined by the choice of the Epiwork logo and the project website layout. The project web site (constituting the **deliverable D8.2**) has been setup and it is continually updated. It gives an overview about the project and compiles press material and publications. This website is located at http://www.epiwork.eu.



- The scientific outreach is simply stated by the sheer numbers of publications (28 papers in peer reviewed journals) and presentations at conferences (xx talks, lectures and seminars) produced in just one year from the consortium. The project has been also involved and promoting two scientific events:
    - Workshop 'Frontiers in the computational modeling of disease spreading' @ ICCS2010, Amsterdam, The Netherlands, May 31-June 2, 2010
    - White Workshop on Mathematical Biology, Trento, Italy, December 17-19, 2009

- The project has been in contact and exchanged information with similar FET projects and the proactive FET initiatives and projects on science of complex systems for socially intelligent ICT. The consortium is actively participating to the life of the ASSYST coordination action and it has been present at the major initiatives in Complexity such as the ECCS09.
- The project has been very active in organizing outreach activities targeting the large public and aimed at popularizing the project and its results to the non-experts. Among the major successes in this area we list the
    - Epidemic Planet @ INFECTIOUS Art and Science Exhibit
      Science Gallery, Dublin, Ireland, April 17 to July 17, 2009
    - The publication of two "features" article on Physics world aimed at popularizing the project results:
        - - D. Brockmann, Following the Money, Physics World, Feb 2010.
        - - V. Colizza, A. Vespignani, The Flu Fighters, Physics World, Feb 2010
    - The production of a series of instructive video clips that convey ideas, methods and results targeted by the project to the general public:
        - Clip 1: Follow the money by C. Thiemann & D. Grady
        - Clip 2: Tour de Sys, by C. Thiemann & D. Grady
        - Clip 3: Introducing GLEaM, by Van Den Broeck et al.

  These clips are available on the Epiwork website. The clip 1 won the AAAS/NSF International Science & Engineering Visualization Challenge 2009 in the category Non Interactive Multimedia.
- The project, also in view of the unfolding of the H1N1 pandemic crisis, was very effective in communicating results to the media and the popular press through regular press releases that have generated a large number of hits (more than about a hundred in six different countries). A full list of press coverage of the Epiwork activities are reported in the **deliverable D8.6**.
- The project WP5 is taking particular care in exploiting the potentiality of the IMS recruiting to use the web tool as a podium for advertisement and dissemination of the project results. At the same time the web tool is being exploited to amplify the public perception on the issue of communicable diseases and as a new media for information and risk awareness campaign. The IMS teams in the several countries have envisioned strategies and campaign to "advertise" the local platform with the national public (see the detailed press releases above). In each country, i.e. The Netherlands, Belgium, Portugal and Italy, all the national media have been exploited to make raise the population awareness of the existence of the project. With the occurrence of H1N1 influenza pandemic, the role of the IMS in disseminating the project's contribution to the study of the unfolding pandemic has become of crucial importance. UK media campaign to advertise the newly deployed platform has gained resonance due to the contingent public health emergency. Each platform has devised its own campaign, during this first year of Epiwork project, and at the end of the pandemic period all the teams have gathered the material produced by each platform and stored it in a centralized repository accessible to all the WP5 partners. Much of this material has been translated into English, either as summary for a complete translation upon request of the partners or as a complete update in English. All on line material will be placed at the new European Influenzanet website.

Use of resources, deviations between actual and planned person-months per work package and per beneficiary in Annex 1 (Description of Work)

The principal resource required to carry out the project is personnel. During this first period of the project, most of the beneficiaries have used fewer person/months than expected. Nevertheless, all the expected deliverables have been completed and all the foreseen tasks and goals have been carried forward. The effort deviation can be explained by the difficulties that most of the beneficiaries have encountered, especially during the very first months of the project, in filling the needed positions with someone having the minimum required qualifications. On the other hand, the emergence of the H1N1 pandemic influenza strain has created in a short time a good coordination among all the partners that brought an acceleration in the research work of the whole Consortium. At the same time, some of the beneficiaries decided to anticipate personnel efforts for the first year of the project in order to speed up the research because of the extraordinary opportunity of harvesting invaluable data.

4. Deliverables and milestones tables

Deliverables (excluding the periodic and final reports)

TABLE 1. DELIVERABLES[5]									
Del. no.	**Deliverable name**	**WP no.**	**Lead beneficiary**	**Nature**	**Dissemination level**	**Delivery date from Annex I (proj month)**	**Delivered Yes/No**	**Actual / Forecast delivery date**	**Comments**
1.1	Analysis of dynamics on clustered contact networks	1	TAU	O	PU	Month 12	Yes	02/20/2010	
2.1	Implementation of multi-scale proxies networks for human mobility networks from online data-sources: www.geocaching.com www.bookcrossing.com www.wheresgeorge.com, www.eurobilltracker.com	2	MPG	O	PU	Month 12	Yes	02/20/2010	
3.1	Report – Meta-model initial specification, catalogue of relevant data, platform requirements	3	FFCUL	O+R	CO	Month 8	Yes		
3.2	Prototype of the	3	FFCUL	P	CO	Month 12	Yes	02/08/2010	

5 For Security Projects the template for the deliverables list in Annex A1 has to be used.

	Epidemic Marketplace Platform with an initial set of epidemiological databases integrated available to the participants								
4.1	Static single layer visualization techniques (choropleth maps, distortions, dasymetric maps) and simple mashups.	4	ISI	P	PU	Month 12	Yes	02/05/2010	
5.1	Design of "Gold Standard", design and implementation of an internet database with English language and documents	5	AIBV	P	PU	Month 12	Yes	02/01/2010	On time. All activities are finished, however, finalization in congruence with IMS database and European website launch in March 2010.
5.2	Extension of IMS for collating contact pattern information and household influenza transmission data	5	AIBV	P	PU	Month 12	Yes	02/01/2010	
6.1	A fully functioning technical infrastructure for the PBA surveillance	6	SMI	D	PU	Month 12	Yes	02/20/2010	

Milestones

TABLE 2. MILESTONES							
Milestone No.	Milestone name	Work package no	Lead beneficiary	Delivery date from Annex I	Achieved Yes/No	Actual / Forecast achievement date	Comments
4	Epidemic Marketplace Platform with an initial set of epidemiological databases integrated available to project participants	3	FFCUL	Month 12	Yes	02/08/2010	
8	Design and implementation of an internet database with English language documents	5	AIBV	Month 12	Yes	02/01/2010	
11	A fully functioning technical infrastructure for the PBA surveillance in Sweden	6	SMI	Month 12	Yes	02/20/2010	

5. Project management

This work package & coordinates the administrative life of the consortium and the scientific work of the project. In particular it ensures that the management plan is carried out, monitors the project and correct deviations from project goals, coordinates the interaction with the Commission, prepares the delivery of the annual progress report containing the activities (including those with no specific deliverable in that reporting term). A framework for the communication within the consortium participants as well as the associated partners has been set up from the very beginning. An internal area of the project website is being used for the exchange of information between the partners keeping them updated about the work in progress and providing assistance on development of special working groups. In particular, the members of WP7 have made use of all the IT tools available to enhance communication and exchange of information between the consortium partners. A development wiki has been set up at the address: http://wiki.epiwork.eu. The wiki page allows the easy creation and the editing of any number of interlinked pages and it creates a collaborative website used to identify, create, represent and distribute all kind of information among the users. During the first project period, the Project Board organized the following management meetings:

- Epiwork Kick-off Meeting in Torino, February 3-4 2009;
- Epiwork WP5 First Meeting in Amsterdam, May 25-26 2009;
- Steering Committee Meeting in Torino, November 16-18 2009;
- Epiwork Annual Meeting in Torino, November 16-18 2009.

Detailed information on the meetings are found in the **deliverable D7.1**.
The financial management of the project, the establishment of a consortium agreement and all the reporting activities (WP&: D7.1) have been carried out without major problems.

5.1 Consortium Management tasks and achievements

The project management approach considered for the first project period of Epiwork has been based on well-consolidated management plans and techniques, which have been used successfully in previous international projects. The primary goal of our management structure is to be capable of responding to the needs of the Project without imposing intrusive or costly time and resources overheads.
The management of the project can be divided into three different categories.
Project Management: This category encompasses the ordinary management of the project, the coordination of the management efforts and the communication within the consortium.
Financial Management: This category encompasses for the control of overall project expenditure, as well as for cost report collection, check and payment.
Scientific Management: This category encompasses the co-ordination of operative efforts within a scientific and technical scope, including the responsibility for the scientific and technical decisions taken in the project and the control and corrections of these decisions.

The management structure of the consortium includes the **Project Coordinator**, the **Steering Committee,** and **the project board.** An important role is attributed to the **WP-leaders** who are responsible for the WP coordination.

As coordinator of the project we appointed Prof. Alessandro Vespignani. As stated in the Annnex I of the Grant Agreement the project coordinator has the overall responsibility for the project. He is the main interface between the project and the European Commission and communicates all information in connection with the Project to the Commission.
The project coordinator has provided unique e-mail address (epiwork@isi.it) that is being used for all official communications regarding the project. The project coordinator is taking advantage of the

ISI internal management structure to delegate specific tasks to a **financial manager** and a **project manager**.
These delegated tasks includes but are not limited to: arrangement of meetings and minutes-related activities, issuing of periodical reports, billing of efforts and budget, financial management activities and acting as interface between the consortium and the financial department of the co-coordinating partner in order to ensure that all payments are properly performed, that the appropriate amounts were received by partners.
During this first project period the ISI Management kept contacts with all the Partners sending in due time the advanced payments, all the information required and where necessary all the administrative controls and assistance for the preparation of the cost statements. The ISI kept also contact with the EU officers in charge for the contract and/or its administration, collecting, drawing up and sending the required data and documents.
According to their specific competences, the staff working in the management is composed by ISI permanent staff:

1. Mrs. Enza Palazzo, Project Manager;
2. Mr. Roberto Palermo, Financial Manager;

The most important management task was and still is taking the project under a complete control giving complete assistance to the scientific Epiwork team.
The financial management was carried out in compliance with all requirements of the contract.

The **steering committee** (SC) assists the Coordinator and it is the governing scientific and technical body of the project. The chairs and the WP-leaders compose the full SC**.**
During the first project year, ISI organized in Torino the EPIWORK Kick-Off Meeting from February 3 to 4, 2009 with the participation of all WP leaders. The agenda and the minutes of the meeting have been reported in detail in the deliverable D7.1.
The Epiwork Steering Committee met again during the first project meeting from Nov
ember 16 to 18, 2009 in Torino in order to discuss the status of the project advancement in terms of scientific achievements and results and in terms of cooperation among the different working teams. The Steering Committee agreed that there had been no conflicts among the partners and no significant deviations from the project plant.

Just after the beginning of the project a Consortium Agreement has been issued in order to provide rules and terms of reference for any issue of legal nature concerning the co-operation among the parties as well as the intellectual property rights of individual partners and the consortium as a whole.

The members of WP7 have the task to provide administrative and scientific work, including the consortium meeting and the commission evaluation reports. A framework for the communication within the consortium participants as well as the associated partners has been set up from the very beginning. An internal area of the project website is being used for the exchange of information between the partners keeping them updated about the work in progress and providing assistance on development of special working groups. In particular, the members of WP7 have made use of all the IT tools available to enhance communication and exchange of information between the consortium partners. A development wiki has been set up at the address: http://wiki.epiwork.eu. Aside the wiki platform, several mailing lists have been set up to allow a more efficient exchange of email among the several partners. The details of all the activated mailing lists can be found at the address: http://lists.epiwork.eu/mailman/listinfo.

5.2 Problems occurred and how they were solved
We can say that during the whole first period project duration we did not find any particular conflict on management.

5.3 Changes in the Consortium
During the first year project no changes have occurred to the Epiwork Consortium.

5.4 List of project meetings, dates and venues
During the first project period, the Project Management organized:

- Epiwork Kick-off Meeting in Torino in February 3 - 4 2009;
- WP5 first meeting in Amsterdam in May 25-26 2009;
- Steering Committee Meeting in Torino, in November 16 - 18 2009;
- Epiwork Annual Meeting, Torino in November 16 - 18, 2009;

All details of the above-mentioned meetings can be found in D7.1

5.5 Project planning and status
The project has progressed according to schedule; no deviations from the roadmap of the project are expected at the moment.

5.6 Impact of possible deviations from the planned milestones and deliverables
No deviations from the planned milestones and deliverables have been observed during this first project period.

5.7 Any changes to the legal status of any of the beneficiaries
On July 10th, 2009 we informed the European Commission by registered letter with acknowledgment of receipt of the change of ISI Authorised representative to sign the grant agreement or to commit the organisation for this project.
In fact from June 8th, 2009 Prof. Mario Rasetti is the new President and Legal Representative of our Institution.

5.8 Development of the Project website
According to the Annex I to the project , the public is continuously informed about the Epiwork project by a constantly updated website. It gives an overview about the project and give compile press material and publications.
This website is located at

http://www.epiwork.eu

This web site is promoted by links from the partners web sites as well as from the Cordis web site.
See D8.2 for all the technical details.

5.9 Use of foreground and dissemination activities during this period
The project has been extremely successful in coordinating and promoting outreach and dissemination activities as well as establishing contact with agencies and institutions aimed at maximizing the social impact of the project. A full description of the foreground and dissemination activities carried on during the project has been reported in the previous section, in the WP8 description of Progress towards objectives as well as in D8.6.

5.10 Cooperation with other project/programmes

The project has been in contact and exchanged information with similar FET projects and the proactive FET initiatives and projects on science of complex systems for socially intelligent ICT.

EPIWORK established several connections with other European funded projects, in particular the Integrated Project EPIFOR (E.C. ERC Grant Agreement n. 204863) and the STREP DYNANETS (E.C. Grant Agreement n. 233847).

EPIFOR is a one-partner project, hosted by ISI Foundation and whose beneficiary is Dr. Vittoria Colizza, with a duration of 5 years. The aim of the project is to give an answer to many fundamental theoretical questions. How does the complex nature of real world affect our predictive capabilities in the realm of computational epidemiology? What are the fundamental limits in epidemic evolution predictability with computational modeling? How do they depend on the level of accuracy of our description and knowledge of the state of the system? The present project aims at developing a vigorous research effort along two main directions corresponding to i) the formulation of models for the basic theoretical understanding of multi-scale and agent based approaches and their predictive power; ii) the development of computational approaches and data integration tools that will provide a realistic modeling framework for the analysis of observed epidemic outbreaks and the forecast of patterns of emerging diseases. The two projects, EPIWORK and EPIFOR, share the common goal to advance the ability of the European scientific community of forecasting the unfolding and spreading of already existing and new infectious diseases.

The FBK team is part of the EU-FP7 FLUMODCONT project that aims the study of the social acceptability of public health measures during a pandemic, and of the behavioural changes that are to be expected in such circumstances. The Epiwork and Flumodcont projects have continuously shared information and results through the FBK team and cooperated in the organization of the ICCS event.

The project DYNANETS is a consortium of 6 partners from different research areas – from physics to computer science, to HIV clinical studies, etc. – with the aim of investigating, in a unified framework, the dynamic networks underlying natural, social and technological systems. In this direction, interactions between EPIWORK team and DYNANETS team offer new opportunities to characterize the dynamical aspects of human interactions and mobility, relevant to the spread of respiratory infectious diseases.

The consortium is actively participating to the life of the ASSYST coordination action and it has been present at the major initiatives in Complexity such as the ECCS09. The coordination action ASSYST is funded from the FET Proactive initiative Science of Complex Systems for Socially Intelligent ICT (COSI-ICT) and has several goals: promote CS & COSI-ICT research, organise many scientific meetings in Europe, in the new member states, in the candidate states, with the USA and South America, with Japan, China and India, and with Africa, make better connections between complex systems scientists and potential business users of complex systems, support the European Conference on Complex Systems. EPIWORK project has participated to the kick-off meeting of ASSYST project, in Paris February 27,28 – March 1, 2009. Moreover, EPIWORK has participated to the COSI-ICT satellite meeting at the European Conference on Complex Systems in Warwick, September 23, 2009.

6. Explanation of the use of the resources

We give here a brief description of the work performed during the first period (01.02.2009 – 31.01.2010) by each of the contractors listed in the below Table together with the Work Packages in which they are involved.

Beneficiary Number *	Beneficiary name	Beneficiary short name	Country	Date enter project	Date exit project
1(coordinator)	Fondazione Istituto per l'Interscambio Scientifico	ISI	Italy	1	48
2	Fundação Calouste Gulbenkian	FGC-IGC	Portugal	1	48
3	Tel Aviv University	TAU	Israel	1	48
4	Max Planck Gesellschaft zur Foerderung der Wissenschaften E.V.	MPG	Germany	1	48
5	Acquisto Inter BV	AIBV	The Netherlands	1	48
6	London School of Hygiene and Topical Medicine	LSHTM	United Kingdom	1	48
7	SMITTSKYDDS Institutet	SMI	Sweden	1	48
8	Katholieke Universiteit Leuven	KULeuven	Belgium	1	48
9	Bar Ilan University	BIU	Israel	1	48
10	Fondazione Bruno Kessler	FBK	Italy	1	48
11	Center for REsearch And Telecommunication Experimentation for NETworked communities	CREATE-NET	Italy	1	48
12	Faculty of Sciences University of Lisbon	FFCUL	Portugal	1	48

ISI
Work packages in which the team was involved: WP3/WP4/WP5/WP8
ISI is supporting one researcher, Dr. Daniela Paolotti, whose contract started on February 1, 2009. Her total efforts during the first project period were:
- WP3: 2,30 person-month for an expenditure of Euro 9.446,30;
- WP4: 4,77 person-month for an expenditure of Euro 19.590,80;
- WP5: 4,32 person-month for an expenditure of Euro 17.742,60;
- WP8: 0,61 person-month for an expenditure of Euro 2.505,30.

Travel and subsistence expenses for travel and subsistence purposes during the first year project is of Euro 1.797,08 (WP5).
About dissemination activities (WP8), Dr. Paolotti participated to some important meetings, such as the International Symposium on viral respiratory disease (Sivilla – Spain, March 25-28, 2009), the Conference "Medicine 2.0" (Toronto –Canada, Sept. 16-19, 2009) and the ECCS 2009 Meeting (Warwick – UK, Sept. 21-25, 2009).

During this first project period most of the equipment, whose purchase was foreseen in the project budget, has been bought. The purchased equipment is necessary for the large-scale numerical simulations as explained in the Annex I of the project. Two high-end laptops have been purchased in order to allow the researchers of the team to pursue their work, also while visiting collaborators. The cluster purchased will be used to perform heavy computational works. In addition the team is taking advantage of the high profile computational facilities present at the host Institution.

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 1 FOR THE PERIOD

Work Package	Item description	Amount	Explanations
WP3, WP4, WP5, WP8	Personnel costs	49.285,00	1 Post-Doc (Dr. Daniela Paolotti) for 12 person-months: 2,30 on WP3, 4,77 on WP4, 4,32 on WP5 and 0,61 on WP8
-	Subcontracting	0,00	-
WP5	Major cost item "Travel and Subsistence"'	928,00	Participation of Dr. Paolotti to the Epiwork WP5 project meeting in Amsterdam (NL) from May 24 to 27, 2009
WP8	Major cost item 'Dissemination'	1.503,00	Participation of Dr. Daniela Paolotti to the International Symposium on "Viral Respiratory Disease Surveillance", Sivilla (Spain), from March 25 to 28, 2009
WP4/WP5	Major cost item 'Durable Equipment'	1.847,00	Depreciation amount for the purchase of one Cluster E5108 bought from E4 Computer Engineering – Invoice n. 808 dated 15/07/2009.
WP7	Management – Personnel	26.635,00	Mrs. Enza Palazzo for 4,43 person-month and Mr. Roberto Palermo for 1,53 person-month
WP7	Management – Travels	12.760,00	Travel and Subsistence expenses for the organization of the Epiwork Kick-Off Meeting (Torino, February 3 to 4, 2009) and the 1st Epiwork Steering Committee Meeting (Torino, November 16 to 18, 2009)
	Remaining direct costs	6.128.00	Further Travel and Subsistence costs (Euro 869,00), dissemination travels (Euro 4.746,00), depreciation amount for the purchase of one Laptop (Euro 513,00).
	TOTAL DIRECT COSTS[6]	99.086,00	

FCG-IGC

Work packages in which the team was involved: WP1/WP2/WP4/WP5/WP8

During the first project period FCG-IGC spent **10** person-month on the **WP1** topics (Euro 18.676,00), **17** person-months on **WP5** topics (about Euro 31.749,00) and **2** person-months on **WP8** issues (Euro 3.735,00). These efforts were dedicated to the coordination of IMS "Gripenet" including all the associated outreach activities and to research in data analysis and mathematical modelling. Another Euro 7.380,00 were spent for maintenance of the Gripenet website (**WP5**) and other Euro 10.359,00 for the purchase of personal computers and travels to meetings and conferences.

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 2 FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
1,5,8	Personnel costs	54.160,00	*Salaries of 2 researchers and 1 technician*
5	Subcontracting	7.380,00	*Maintenance of the web site*
	Major cost item 'X'		
	Major cost item 'Y' ………..		
	Remaining direct costs	10359,00	
	TOTAL DIRECT COSTS[6]	71899,00	

TAU

Work packages in which the team was involved: WP1/WP2/WP3/WP4

During the first project period TAU spent 14,3 person-month on the WP1 topics (Euro 28.019,00), 6 person-month on WP2 topics (Euro 12.008,00), 2 person-month on WP3 issues (Euro 4.003,00) and 7 person-month on WP4 topics (Euro 14.010,00).

The research activity of TAU focused especially on the study of swine flu contact networks, characterizing and modelling the initial phase of the swine flu (H1N1) epidemic in Israel (WP1), the structure of human mobility networks (WP2), data collection for epidemic marketplace (WP3) and on data driven simulations for analysis and epidemic forecasts.

Another Euro 387,00 were spent on consumables and Euro 3.730,00 for travel and subsistence costs for their participation to meetings and conferences.

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 3 FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
1,2,3,4	Personnel costs	58.040,00	*2 post doctoral students one research assistant and the PI*
	Subcontracting	0,00	
	Major cost item 'X'	387,00	*consumables*
	Major cost item 'Y' ………..	3.598,00	*Travel to APS March Meeting and to the EPIWORK workshop*
	Remaining direct costs	132,00	*Conference attendance (NEGISTRATION IN THE CONFEREUCE "MATHEMATCAL METHOALS SYSTEM ISIOLJY"*
	TOTAL DIRECT COSTS[7]	62.157,00	

MPG

Work packages in which the team was involved: WP2/WP3/WP4

During the first project period MPG spent **14** person-month on **WP2** topics (about Euro 28.781,00) on the structure of human mobility networks , **3** person-month on **WP3** (about Euro 6.167,00) on collecting data for the epidemic market place and other **3** person-month on **WP4** (about Euro 6.167,00) on the data and simulation results visualization.

TABLE 3.4 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 4 FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
2, 3, 4	Personnel costs	41.115,00	Salaries of 2 Ph.D. students for 10 months each
	Subcontracting		
	Major cost item 'X'		
	Major cost item 'Y' ………..		
	Remaining direct costs		
	TOTAL DIRECT COSTS[4]	41.115,00	

AIBV

Work packages in which the team was involved: WP5

During the first project period AIBV spent **7,55** person-month on **WP5** topics (Euro 41.820,00) on the database and software development, on the epidemic modelling and research coordination.

In this period they spent Euro 9.387,00 for management purposes, including preparation, presentation and reporting of three meetings, overall coordination of AIBV activities (**1,4** person-month).

As foreseen in the Annex I of the contract, AIBV spent Euro 56.489,00 on subcontracting for RTD assistance by University of Amsterdam: database infrastructure design, website content renewal, website design and maintenance, content translation.

Another Euro 4.981,00 were spent in travel and subsistence costs for the team participation to Epiwork project and WP5 meetings and Euro 5.042,00 were spent on the purchase of the IMS database server, including maintenance for two years.

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 5 FOR THE PERIOD			
Work package	**Item description**	**Amount**	**Explanations**
5	**Personnel costs** (incl. indirect costs)	41.819,00	*Persons:* Rick Quax: 399 hours in 3 months time, 3 MM Ronald Smallenburg: 660 hours in 11 months time, 4,7 MM *Duties:* RTD and other: database and software development; epidemic modelling and research; research coordination, writing scientific article in Vaccine
5	**Management** (incl. indirect costs)	9.387,00	Three meetings, incl. preparation, presentations, presidency and reporting; overall coordination of AI BV activities and general WP 5 Ronald Smallenburg: 1,4 MM
5	**Subcontracting** (incl. VAT)	56.489,00	RTD assistance by University of Amsterdam: database infrastructure design; Content renewal, website design and webmaster assistance by free lancers; Translations by free lancers Activities in 2009, most invoices in 2010
5	**Travel & subsistence** (incl. VAT)	4.981,00	Two project meetings in Italy: 5-7 February and 14-18 November '09 Two WP5 Meetings: 25-26 May in the Netherlands and 16 Nov. in Italy One FP7 legal and financial training by Dutch NCP (EG Liaison)
5	**Computers (database server)** (incl. VAT)	5.042,00	European IMS database server including maintenance for two years; purchase in 2009, invoice in 2010

5	**Remaining direct costs**	-	
TOTAL DIRECT COSTS[8]		117.718,00	**Excl. VAT**

LSHTM

Work packages in which the team was involved: WP1/WP5

During the first project period LSHTM spent 0,73 person-months on WP1 (Euro 4.561,00) on the potential impact of polygyny on long-duration STI prevalence using simulated sexual networks and 1,77 person-months on WP5 (Euro 3.642,00) on flu survey database and website.

Another Euro 4.528,00 were spent on travels to WP5 project meetings and for the participation to other conferences relevant to the project.

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 6 FOR THE PERIOD

Work Package	Item description	Amount	Explanations
WP1, WP5	Personnel costs	8.203,00	Richard White has submitted papers relevant to EPIWORKS; Natasha Tilston has worked on the flu survey database and website
	Subcontracting		
	Major cost item 'X'		
	Major cost item 'Y'		
	Remaining direct costs	4.528,00	Ken Eames travel to Amsterdam meeting for flu website, EPIDEMICS conference registrations for delegates, internal meeting facilitation costs, advertising for a Research Fellow and Research Assistant for EPIWORKS.
TOTAL DIRECT COSTS[6]		12.731,00	

SMI

Work packages in which the team was involved: WP6

During the first project period SMI spent **28** person-month on **WP6** topics paying salaries for one project coordinator (12 p/m), 1 PhD student (6 p/m), one administrator (8,4 p/m), one manager (0,6 p/m) and one epidemiological consultant (0,24 p/m).

Another Euro 6.359,00 were spent on subcontracting for the development of the reporting system Population Based Approach (PBA).

Euro 15.949,00 were spent for the set-up of the population based surveillance (regular mail sent for invitation to PBA and population samples from the national registry).

Finally Euro 1.276,00 were spent on travel and subsistence costs for Epiwork project and WP meetings.

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 7 FOR THE PERIOD

Work Package	Item description	Amount	Explanations
6	Personnel costs	120.424,00	Salaries of 1 project coordinator (12 months),1 PHD student (6 months), 1 administrator (8,4) months, 1 manager (0,6 month) and 1 epidemiological consultant/(PI) (0,24 month)
6	Subcontracting	6.359,00	Development of reporting system PBA
6	Major cost item 'X'	11.971,00	Postal stamps for invitation to population based surveillance.
6	Major cost item 'Y' ………..	3.978,00	Population sample from the national registry to population based surveillance.
6	Remaining direct costs	1.276,00 €	Travel costs to project meetings and WP meetings
	TOTAL DIRECT COSTS[6]	144.008,00 €	

KULeuven

Workpackages in which the team was involved: WP5

During the first project period KULeuven spent **2,8** person-month on WP5 topics paying salaries for 2 researchers for a total expenditure of Euro 12.426,00. Another Euro 1.191,00 were spent for the purchase of one computer (Laptop) for literature study and questionnaire algorithm building.

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 8 FOR THE PERIOD

Work Package	Item description	Amount	Explanations
5	Personnel costs	12.426,00	Salaries: • J. Amaya: doctoral researcher (1,8MM) • I. Roelandts: doctoral researcher (1MM)
5	Equipment	1.191,00	• Invoice date: 25/09/2009 • Invoice number: 4800063077-G31 • Supplier: Digame • Description: Apple Macbook Pro Use in project: Laptop for literature study and questionnaire algorithm building
	TOTAL DIRECT COSTS[6]	13.617,00	

BIU

Work packages in which the team was involved: WP1/WP2/WP3/WP4

During the first project period BIU spent **4** person-month on **WP1** (Euro 19.140,00), **3** person-month on **WP2** (Euro 14355,00), **2** person-month on **WP3** (Euro 9.569) and **5** person-month on **WP4** (Euro 23.925).

The main research activities carried out by BIU refer to the study of the structure of human mobility networks and the interplay of human mobility and social contact networks (WP1 and WP2), data collection for the epidemic marketplace (WP3) and data driven simulations for case studies analysis and epidemic forecast (WP4).

Another Euro 1.520,00 were spent to purchase a computer and Euro 15.278,00 for travel and subsistence expenses to participate to conferences, for reporting scientific results and for covering travel expenses for research collaborations.

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 9 FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
1,2,3,4	Personnel costs	66.989,00	PI Prof. Shlomo Havlin 25% of his time 6 Researchers 3 Post doctoral students 3 Graduate students
1,2,3,4	Equipment	1.520,00	Computer
1,2,3,4	Travel	15.278,00	1.Confrences 2. Reporting on scientifical results 3. Research collaboration on the project.
	TOTAL DIRECT COSTS	83.787,00	

FBK

Work packages in which the team was involved: WP2/WP3/WP4

During the first project period FBK spent 1 person-month (Euro 5.601,00) on WP2, 1 person-month on WP3 (Euro 5.601,00) and 3 person-month on WP4 (Euro 16.802,00).

FBK carried out in particular research on the dynamics of heterogeneous networks (WP2), on data collection for epidemic marketplace (WP3) and on the role of population heterogeneity and human mobility in the spread of pandemic influenza.

Another Euro 800,00 were spent for a subcontract for the sponsorization of the "White Workshop on Mathematical Biology", held in Trento (Italy) from Dec. 17 to 19, 2009.

Euro 1.821,00 were spent on travels to conferences and to project meetings and Euro 1.333,00 on publication costs for a paper on the Proceedings of the Royal Society B.

Table 3.2 Personnel, subcontracting and other major Direct cost items for Beneficiary 10 for the period			
Work Package	Item description	Amount	Explanations
2,3,4	Personnel costs	28.004,00	Salaries of senior researcher (478 hours) and 2 postdoc (194.6 hours)
	Subcontracting	800,00	Sponsorization of the WHITE WORKSHOP ON MATHEMATICAL BIOLOGY (WWMB) - TRENTO, 17-19.12.09
	Travels	1.821,00	Conferences and project meetings
	Remaining direct costs	1.333,00	Publication of the paper "THE ROLE OF POPULATION HETEROGENEITY AND HUMAN MOBILITY IN THE SPREAD OF PANDEMIC INFLUENZA" - Proceedings of the Royal Society B - The Royal Society
	TOTAL DIRECT COSTS	31.958,00	

CREATE-NET

Work packages in which the team was involved: WP5

During the first project period CREATE-NET spent 6,07 person-month on WP5 issues (Euro 31.378,00) in particular on the development of data gathering solutions based on the use of mobile phones. Moreover they worked on the development of a Facebook application in cooperation with Harward Medical School to collect epidemiological data by means of a flu survey in social networks.

Another Euro 2.830,00 were spent on travel to Epiwork project meetings and Euro 358,00 for the purchase of a mobile phone necessary for the development of the mobile phones application.

TABLE 3.11 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 11 FOR THE PERIOD			
Work Package	Item description	Amount	Explanations
5	Personnel costs	31.378,00	*Salaries of 1 Research team leader (2,04 PMs) and one senior researcher (4,03 PMs)*
5	Subcontracting		
5	Major cost item 'X' (if > 5k)		
5	Major cost item 'Y' (if > 5k)		
5	Remaining direct costs (travels, equipment)	1.969,00	*Travel: Amsterdam Project Meeting – 24-27/05/2009*
5		360,00	*Travel: Trento Project Meeting – 15-17/11/2009*
5		501,00	*Travel: Torino Kick-off Meeting – 02-04/02/2009*
5		358,00	*Equipment: NOKIA telephone N96*
	TOTAL DIRECT COSTS[9]	34.566,00	

FFCUL

Work packages in which the team was involved: WP1/WP3/WP4

During the first project period FFCUL spent 1 person-month on WP1 (Euro 1.535,00), 14,38 person-month on WP3 (Euro 22.071,00) and 5,72 person-month on WP4 (Euro 8.780,00).

The main research activities carried out from FFCUL refer to seasonality and other external environmental drivers in epidemic spreading (WP1), to design and implement an epidemic marketplace platform (WP3) and data and simulation results visualization (WP4).

Another Euro 10.281,00 were spent for travel and subsistence expenditures for Epiwork project meetings and for the participation to dissemination conferences.

Euro 5.443,00 were spent for the purchase of informatics equipment to support the project's activities within WP1, WP3 and WP4.

TABLE 3.2 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR DIRECT COST ITEMS FOR BENEFICIARY 12 FOR THE PERIOD

Work Package	Item description	Amount	Explanations
WP1 and WP3	Personnel costs	32.386,00	Salary costs of the Project´s technicians Luis Lopes, Carla Sousa, Hugo Ferreira, João Zamite and Sebastien Ballestros.
-	Subcontracting	0,00	-
WP1,WP3, WP4, WP7	Travel	10.281,00	Travel costs of Mário Gaspar, Fabrício Silva, Frank Hilker and Nicolaus Stollenwerk related to the attendance of Epiwork kick-off-meeting (Italy, February 2009). Costs concerning the technical meeting for Fabrício Silva and Luís Lopes in Netherlands (May 2009). Costs of Luís Lopes to the attendance of INFORUM 2009 (Lisbon, September 2009). Costs of Nicolaus Stollenwerk to the attendance of ICNAAM, 2009 (Greece, September 2009). Travel costs of Mário Gaspar, Fabrício Silva, Carla Sousa, Frank Hilker and Nicolaus Stollenwerk related to the attendance of the first Epiwork technical meeting (Italy, November 2009).
WP1, WP3, WP4	Equipment	5.363,00	Cost refers to the acquisition of informatics equipment in order to support the project's activities within WP1, WP3 and WP4.
WP3 and WP4	Remaining direct costs	80,00	Equipment Shelf for 24U and 42U Cabinets
	TOTAL DIRECT COSTS[6]	48.110,00	

Financial statements – Form C and Summary financial report

Please submit a separate financial statement from each beneficiary (if Special Clause 10 applies to your Grant Agreement, please include a separate financial statement from each third party as well) together with a summary financial report which consolidates the claimed Community contribution of all the beneficiaries in an aggregate form, based on the information provided in Form C (Annex VI) by each beneficiary.

When applicable, certificates on financial statements shall be submitted by the concerned beneficiaries according to Article II.4.4 of the Grant Agreement.

IMPORTANT:

Form C varies with the funding scheme used. Please make sure that you use the correct form corresponding to your project. Templates for Form C are provided in Annex VI of the Grant Agreement. An example for collaborative projects is enclosed hereafter. A Web-based online tool for completing and submitting the forms C is under preparation. If you have to submit forms C before the tool becomes available, please ask your Commission project officer for an Excel version of the form.

If some beneficiaries in security research have two different rates of funding (part of the funding may reach 75% in reference with Article 33.1 of the EC rules for participation - REGULATION (EC) No 1906/2006) then two separate financial statements should be filled by the concerned beneficiaries and two lines should be entered for these beneficiaries in the summary financial report.

7. Certificates

List of Certificates which are due for this period, in accordance with Article II.4.4 of the Grant Agreement.

Beneficiary	**Organisation short name**	**Certificate on the financial statements provided? yes / no**	**Any useful comment, in particular if a certificate is not provided**
1		Yes	
2		no	
		no	Expenditure threshold not reached
Etc.			

A copy of each duly signed certificate on the financial statements (Form C) or on the methodology should be included in this section, according to the table above (signed originals to be sent in parallel by post).